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CONSUMER PRODUCTS BY DESIGN

a report on new foods, fabrics, and materials from agricultural research

Prepared by
Agricultural Research Service

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CONSUMER PRODUCTS BY DESIGN

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AGRICULTURAL science in the 1970's is facing a critical test of its ability to serve consumers. Consumer needs have been changing—often dramatically—in recent years, and science must continue to develop new products that will meet these needs.

With higher incomes, increased mobility, and more leisure time, Americans are looking for food products that are more versatile, easier to prepare, and higher in nutritional value. Demand is also growing for better fabrics; working mothers are asking for attractive family clothing that requires a minimum of care.

These and other needs must be given prime consideration in planning any program of research on consumer products. An equally important consideration is that of making more efficient use of the Nation's farm resources and assuring farmers of a wider market for their goods.

Chances for success in attaining both goals depend heavily on getting accurate answers to several important questions. First of all, will the consumer readily accept the new product? This, of course, is the ultimate measure of success. Even if consumer acceptance is reasonably certain, however, still other questions must be considered.

One concerns the farmer's ability to produce the necessary raw material. To do this, would it be necessary for him to revise his livestock management practices or to convert his acreage to a new variety or to new crop management practices?

What about the processor or manufacturer? Would he need to modify or replace his present equipment or to retrain his personnel?

The distributor may also have some problems, too. Perishable food products are especially sensitive to transport and storage conditions. Will the product maintain its quality, flavor, and appearance from the time it is processed until it reaches the consumer?

Finally, the retailer's position must be considered. Can the new product com-

pete for the retailer's limited shelf space with other similar products that he presently sells? How much advertising and promotion will be necessary to make consumers aware of the new product?

These are all practical questions that can most likely be answered through research, experimentation, and field testing. Much more elusive is the consumer mystique—the very personal considerations that lead them to accept or reject a new product.

Checking the list of products that have "made it"—like concentrated orange juice and durable-press cottons—leads one to the conclusion that consumers accepted these items because they satisfied very clearly defined needs. Determining whether a given product, will meet such a need is most difficult, however, for consumer expectations are continually changing.

Take foods, for example.

A generation ago, consumers were probably most preoccupied with taste and appearance. More recently, they began to look for convenience, quality, and durability.

Today, consumers are becoming increasingly concerned with food quality, particularly as measured by its nutritional value. Agricultural science is already working on ways to upgrade the nutritional value of foods and to establish "good nutrition" standards and guidelines for food processors. At the same time, research is producing more nutritious lines of crops, livestock, and poultry. Improved wheat and oat varieties with higher protein contents have already resulted from this work.

Livestock researchers are breeding for decreased waste fat, thus giving consumers a meat product with a higher protein yield. A lean meat-type hog has been successfully developed, and the same approach is being used with beef cattle.

Many other new products reflect efforts to meet even more specific requirements. For example, weightwatchers are showing a preference for defatted peanuts because this food item combines a lower calorie count with an appealing flavor. Also, identification of the interaction of two organisms in the formula for San Francisco's famed sourdough bread is expected to give consumers in every part of the country an opportunity to taste this specialty food item. MOD, a blended mixture of milk and orange juice, will appeal to those who like both of these nutritious drinks.

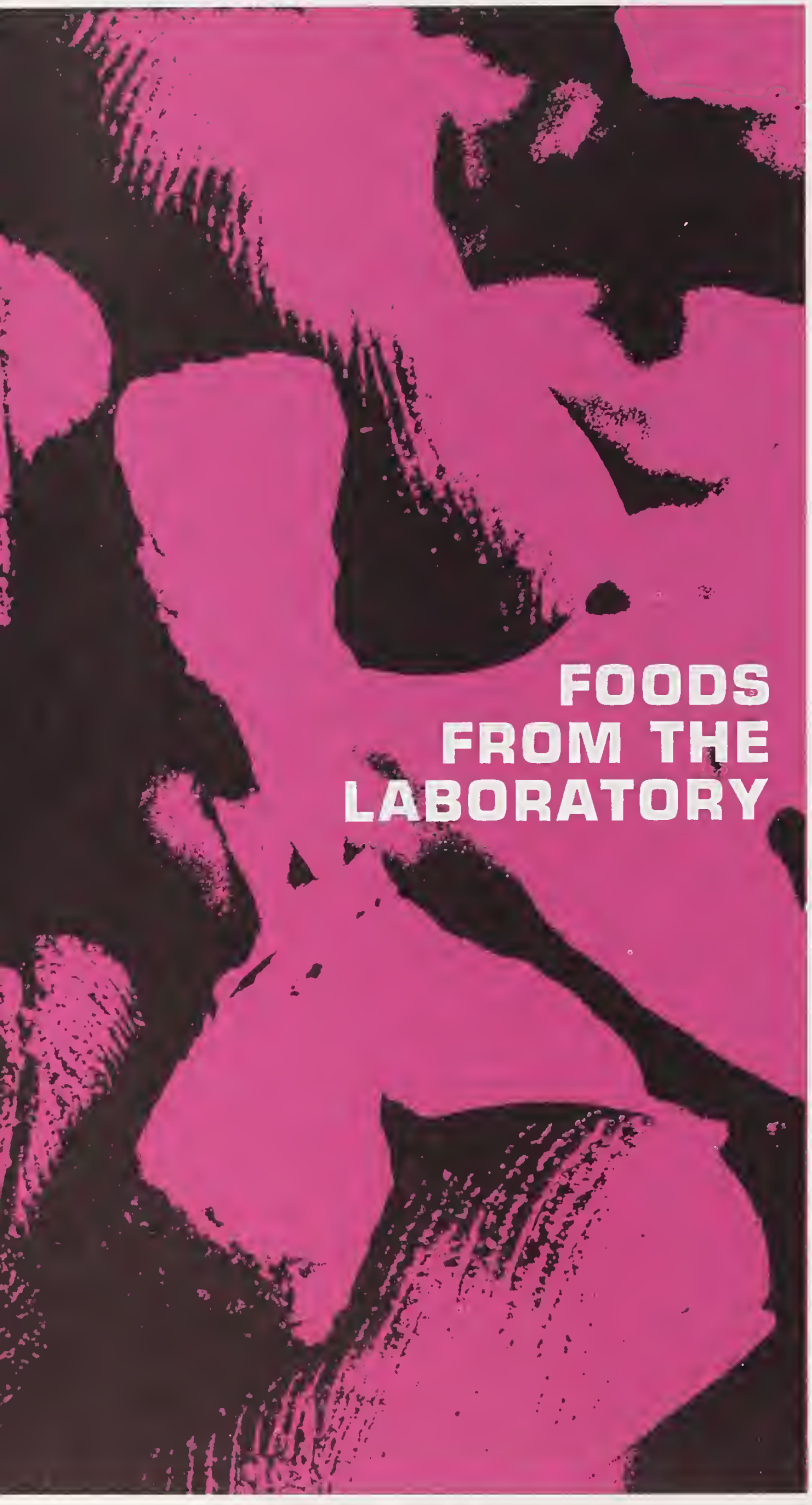
As far as fabrics are concerned, the new flame-resistant cottons and wools should find uses in children's clothing and in uniforms for firemen. Consumers can look for increasing use of the new stretch fabrics in a variety of clothing items.

Another class of new agricultural products will benefit consumers in a more indirect sense. These items, which are being developed for industrial purposes, include linseed oil emulsions that are used in curing wet concrete in highways and bridges, as well as new phosphate-less detergents made from animal fat.

Besides appealing to consumers, some of the new products also help to reduce environmental pollution by cutting down on the volume of waste materials created by processing. One such product is Orange-Ho, a deliciously sharp orange drink. More of the whole orange is used in producing this beverage than is used in producing orange juice. Most of the smaller volume of waste is converted into dehydrated animal feed.

Research on these and similar products is in a constant state of evolution that is fueled by constantly changing consumer needs. By remaining responsive to these needs, agricultural research can continue to improve the lives of millions of people, both here in the United States and throughout the world.

Administrator, ARS



FRESH foods are great, but processed foods make up the diets of most Americans. The challenge for agricultural scientists, then, is to make processed foods as "good as fresh." The scientists are enjoying considerable success in meeting the challenge.

Here are some well-known examples: dehydrated mashed potatoes; homogenized milk and other dairy products; canned and frozen fruits and vegetables; freeze-dried coffee; and full-flavored jams and jellies.

Today's consumer has good reason to demand processed foods. They are quick and easy to use, and available no matter what the season. They also offer him familiar foods with tempting new forms and tastes.

Agricultural scientists have done their work well to give us the variety and abundance of processed foods. More important, they are finding ways to provide these foods to the market place at their peak of flavor, attractiveness, and nutritional value.

New processed foods coming from agricultural research laboratories include:

ORANGE FOODS

Instant orange crystals and **orange juice tablets (O. J. Tabs)** are new ways of getting vitamin C into the diet. These products were developed in cooperation with the Florida Citrus Commission.

- Instant orange crystals are made by dehydrating concentrated orange juice with a special process. They contain about 97-percent natural citrus solids and have no added sugar. When reconstituted, instant orange juice tastes like regular orange juice and has all its nutri-

tive benefits including calorie content, vitamin C, other vitamins, and minerals. Unlike regular orange juice, the instant kind does not have to be refrigerated.

Instant orange crystals are desirable as a flavoring for a wide variety of foods, such as cakes and candies. Instant orange has been used by military personnel, and was specially packaged for the astronauts on their Apollo flight. It will soon be available to the general consumer.

- O. J. Tabs are made by compressing instant orange juice powder into tablets. These tablets do not have to be refrigerated or reconstituted, and they are eaten like candy. Eight have about the same food value as one orange.

O. J. Tabs are ideal for campers, servicemen in the field, and other people in areas where refrigeration is not available or storage space is limited. Similar tablets can be prepared from grapefruit or various combinations of citrus and berries.

MOD—short for milk-orange drink—is a refreshing and nutritious beverage that looks like milk with a pale-orange cast.

MOD tastes like creamy orange sherbet. When taste-tested, people of all ages liked it. Because it is a little thicker than milk, it becomes frothy when chilled. It has a longer shelf life than the milk from which it is made.

Nutritionally, MOD combines the protein and minerals of milk with the vitamins of orange juice. By weight it has 38-percent orange juice, 56.8-percent whole milk, 5-percent sugar, and 0.2-percent of a stabilizer to prevent curdling. MOD is pasteurized and homogenized, just like whole milk.

MOD is ideal as a breakfast drink or after-school snack. It was developed cooperatively with Dairy Development, Inc., an organization representing dairy cooperatives of the Northeastern United States.

BEV — 0 — 3

New orange products retain all the nutritive benefits of fresh oranges. They are MOD in pitcher, Orange-Ho in bowl, reconstituted instant orange juice powder in glass, and orange juice powder and O. J. Tabs in small dish.

Orange-Ho is a beverage made from whole oranges. The rinds, pulp, and juice of the orange all go into Orange-Ho. (Only the rag, seeds, and very tough

parts of the rind are discarded.) The result is a tangy orange drink—with added nutrients from the rind. Less than half of the orange is used in ordinary orange juice. Orange-Ho, by contrast, uses almost 90 percent.

Orange-Ho is made by grinding the oranges into a homogenized puree. The puree is strongly flavored and has to be diluted and sweetened.

Other drinks can be made from the whole orange puree by adding other fruit purees or juices.

NEW WAYS WITH FRUITS AND VEGETABLES

Osmovac fruits are sugar-dried fruit slices that have a crisp, honeycomb-like texture.

An osmotic process draws 60 to 70 percent of the moisture out of the fruit, which has been placed in heavy concentrations of sugar sirup or in dry sugar. This is followed by final drying in air or vacuum. The combination drying produces fruit with better color and flavor than air-dried fruit.

These dried fruits—which include bananas, apples, peaches, and strawberries—can be eaten with cereals or as snacks. They also can be used in baked goods, desserts, and salads. A tasty confection made with the osmovac process is the chocolate-covered banana.

A large commercial food processor is now gearing up to produce osmovac fruits for the retail market.

Precooked dehydrated sweetpotato flakes, a new vegetable product, are convenient to use and will keep in storage for over a year.

The flakes are bright orange and have a candied sweetpotato flavor. Reconstituting the dehydrated flakes is very simple—just add an equal volume of hot water or milk to the flakes and stir lightly for about 1 minute.

The reconstituted flakes can be eaten as mashed sweetpotatoes and, seasoned to taste, can also be used for pie filling, in casserole dishes, and in a large number of other food recipes. These flakes are being produced commercially.

Explosion-puffed apples are crisp, dried apple pieces that can easily be reconstituted. The pieces are baked into pies and other pastries or can be eaten as snacks.

Explosion puffing is a means of giving quick-cooking properties to dehydrated

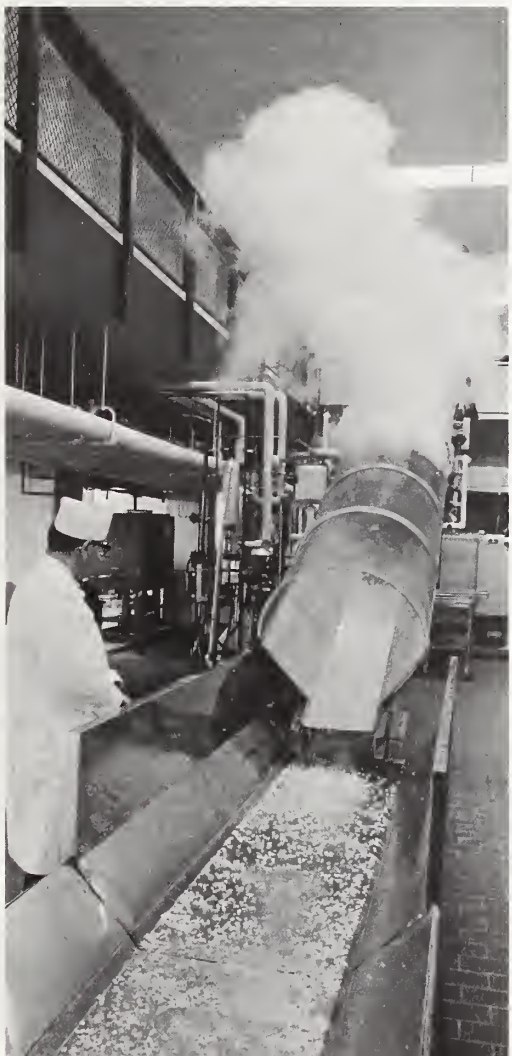
FOOD — 0 — 16

Osmovac dried fruits have the color and flavor of fresh fruits and are good in cereals or as snacks.

fruits and vegetables. In general, the process involves (1) preparing the raw food, (2) partial drying to a moisture content suitable for puffing, (3) sudden release of pressure while a fruit or vegetable is rotating in a steel drum, and (4) final drying to a low-moisture content.

Explosion puffing has also been successful with both diced and sliced pieces of many fruits and vegetables, including white potatoes, carrots, beets, sweetpotatoes, and blueberries. Explosion-puffed fruits and vegetables are superior to conventionally dried products on a cost-quality basis. At least one firm is producing carrots by this process in bulk quantities for institutional use.

1170A1064–2
Broken apple snack has a porous structure characteristic of explosion puffing.



1170A1056–22
Apple pieces emerge from a puffing gun. In explosion puffing, fruit or vegetable pieces are rotated in a drum until the desired temperature and pressure are reached; then the pieces are ejected and part of the water immediately vaporizes. Heat is used to remove the rest of water.

PROTEIN-RICH FOODS

The worldwide need for dietary protein poses a problem that demands solution.

If present trends continue, consumer demand for vegetable proteins will increase rapidly. Researchers are continually looking for new and better products to supply this protein.

Cottonseed flour, containing about 65-percent protein, was produced by ARS scientists after they had developed a way to remove the inedible pigment glands from cottonseed.

Cottonseed flour makes highly acceptable bakery products if mixed with wheat flour. When cottonseed flour replaces 20 percent of the wheat flour in cookies,

MEAL SNACK — 0 — 6
Miso, a high-protein Oriental food, is delicious to eat either as a dark spread on plain crackers or a light-colored dip with raw vegetables. As a result of a new method for processing soybeans developed at an ARS laboratory, miso can now be made from American soybeans.

the protein content of the cookies is more than doubled. Likewise, cottonseed flour can be added to crackers, breads, biscuit mix, spaghetti, and macaroni to increase their protein content.

Cottonseed flour also shows promise for use in the meat and beverage industries.

A small plant in India is producing cottonseed flour using the ARS process, and a cottonseed processor in the United States is installing facilities to produce this flour.

Soybean beverage powder is an instant mix that makes a high-protein beverage. The powder disperses in water to form a cream-colored liquid.

In laboratory studies, soybean powder was blended with sugar, salt, imitation cream flavoring, minerals, and vitamins. The amounts and kinds of these additives can be adjusted to satisfy different nutritional needs and to suit the tastes of people in different countries. A beverage containing 12.5-percent soybean powder has the nutrient composition of whole milk.

Milk curd, fried in deep fat, is a new high-protein food from the laboratory. Because it is very bland, it can be flavored for any taste. Fried milk curd has good texture, resembling meat, and can be eaten hot or cold. It can be canned and keeps well in the refrigerator.

Some of its possible uses are for snacks, hors d'oeuvres, and confections.

WEIGHT WATCHERS

Low-fat peanuts (or partially defatted peanuts) are good news to people who like peanuts and have to watch their weight. These low-fat peanuts are produced by removing a large percentage of the oil—and at the same time about half of the calories. The peanuts are lighter-colored and crunchier than other peanuts.

Oil is pressed out of the peanuts mechanically. The pressed peanuts are flat and misshapen, but are returned to their original shape and size by soaking them in water. Salt or other flavoring ingredients can be added during this step. Finally, the peanuts are dried and roasted.

Low-fat peanuts can be produced with many variations. The calorie content can be changed by the amount of oil re-

FOOD — 0 — 17

Partially defatted peanuts (in dish) are high in protein and low in calories.

MEAL SNACK — 0 — 7
Euda cheese, made from skim milk, goes well with famous San Francisco sourdough bread, which may soon be baked in all parts of the country.

moved; different flavors can be added; and the peanuts can be fortified with vitamins, minerals, and amino acids for added nutrition. Low-fat peanuts may provide an important protein source for children in developing countries.

Low-fat peanuts make a good snack. They can also be used in soups, candies, and other processed foods. These peanuts are on the retail market in some parts of the country. Two products being produced from low-fat peanuts for bulk use are simulated black walnut and simulated pecan pieces.

Cream and cheese whey spread is a unique product that contains fewer calories than butter or margarine and is rich in vitamins, lactose (milk sugar), and proteins.

It is made from one part cream and six parts fluid sweet cheese whey—a byproduct of Cheddar, swiss, and other "sweet-type" cheeses. The mixture of cream and whey is pasteurized and homogenized. It contains 35- to 37-percent fat, 38- to 42-percent nonfat solids, and 25-percent moisture.

Whey spread has about 130 calories per ounce (2 tablespoons); butter has about 200. The new product is easy to spread at temperatures from 45° to 100° F.; butter is hard at 45° and nearly liquid at 100°. Whey spread can be stored at room temperatures for a week without serious effects on taste and consistency, and it can be kept up to 4 to 5 months at 45° in sealed containers.

This new spread can help our pollution problem by using whey, a largely wasted byproduct of cheesemaking. Whey is nutritionally too good to throw away, yet only one-third of the 22 billion pounds of whey produced annually in the United States is being used.

EUDA cheese is the first cheese made from skim milk that has texture, body, and flavor suitable for table use. It

should prove popular with weight-conscious consumers. Semi-soft, it looks and tastes like a very mild Cheddar.

EUDA has more protein than Cheddar cheese and much less butterfat. EUDA contains only 5- to 7-percent butterfat compared to Cheddar, which contains 31 percent.

Low-fat cheeses are now on the market. More than 100 cheese manufacturers and food processors have requested and been given instructions for the manufacture of EUDA. Several other commercial companies are producing their own version of a low-fat cheese relying heavily on research from ARS.

LAMB PRODUCTS

Lamb curry, smoked lamb sausage, lamb loaf, boned lamb shanks in sauce, rolled stuffed breast, barbecued riblets, and **shish kebabs** are convenience-prepared lamb products that should encourage a renewed consumer interest in lamb.

In two preliminary tests with university students and homemakers, curry and rice, sausage, and loaf were the most widely accepted of the new products.

- Curry and rice, a traditional lamb dish, was packaged in boil-in-bag containers for the tests with homemakers and was served over rice in the students' cafeteria.

- A tomato-base sauce was developed for use with the shanks, riblets, and stuffed breast. Boned shanks are precooked in the sauce and packaged in boilable bags. In taste tests, they were preferred to .the riblets and breast by both students and homemakers.

- Lamb curry is a fully prepared and cooked meat dish in the form of a sauce made from cubes of lamb shoulder, seasonings, fruits, and vegetables. It is packed in frozen form and stored in boilable bags. On reheating, it may be served over rice, noodles, or toast. Lamb curry was rated as highly acceptable by a trained taste panel and as good or acceptable by 98 percent of a home panel.

- Lamb loaf is made from ground lamb, various vegetables, and seasonings. This frozen meat loaf is an oven-ready entree.

- Lamb riblets, the spareribs section of lamb, are cooked in barbecue sauce and packaged in boilable bags for freezing. Riblets are good as a finger food. They were considered excellent in flavor tests.

- Smoked lamb sausage is made from carcass shoulders or chunks of lamb, with seasonings. The sausage was rated as very good or acceptable in juiciness, tenderness, and texture.

- Shish kebabs, marinated lamb cubes, are packaged in a moisture-proof plastic bag and frozen. When thawed for use, the cubes are skewered with appropriate vegetables and broiled. This product was rated highly acceptable by a trained taste panel.

The new lamb products were developed and evaluated under a contract awarded by ARS to the Pennsylvania State University with the American Lamb Council cooperating in the research.

IMPROVED PRODUCTS

Instant dry whole milk disperses easily in cold water and has the flavor of fresh

whole milk. In dry form, it may be stored at least 6 months in the home refrigerator.

Although dry skim milk has long been a familiar product, techniques used to dry it have not been satisfactory for drying whole milk.

ARS scientists have now developed a way to do the job—by vacuum foam-drying. In market tests of foam-dried whole milk, the new item sold well and consumer acceptance was high. Purchasers liked its taste, ease of mixing, and storage convenience. They also liked its cost, which was about 10 percent lower than fresh whole milk.

The dairy industry is interested in manufacturing this product, and consumers will be able to buy it in the future.

Crisper french fries are on the way. Scientists have shown that heating the potato strips under infrared lamps before freezing them reduces the amount of oil absorbed during cooking and improves the crispness and shape of the finished french fries. The lower oil content would make them appeal to calorie-conscious consumers.

The new frozen french fries can be cooked in the home oven and still maintain the flavor, crisp surface, and internal texture of french fries cooked in oil.

Individual quick blanching (IQB) means more nutritious vegetables. Valuable nutrients lost during the blanching of vegetables with steam or hot water become pollutants in the output from canning and freezing plants. IQB retains up to 90 percent of these nutrients, because no excess water is used and most soluble nutrients remain in the vegetables. Every vegetable piece is quickly and uniformly heated without overcooking.

Tests were made on such vegetables as carrots, beets, lima beans, and green beans. During the 1971 processing season, pilot-scale demonstrations were held in two plant locations, and commercial use of IQB is expected in 1972.

The IQB method was conceived by ARS engineers and developed cooperatively with scientists at the University of Wisconsin.

Better frankfurters result when meat ingredients are chopped at the highest practicable temperature, research has shown. Also, franks made with beef fat were preferred in taste tests over franks made with pork fat or cottonseed oil. Cottonseed oil was the least-favored fat.

Results of ARS research on frankfurters have been made available to industry.

Precooked cornmeal, another development from agricultural research, makes corn dispersible in water so that it can be used in an instant infant formula mix.

The United Nations Children's Fund (UNICEF), in cooperation with USDA and the Agency for International Development (AID), has used this mix (called CSM) to feed babies and small children in many foreign countries including India, Iraq, Madagascar, Thailand, and several African countries. Recently (October 1971) some 20 million pounds of CSM were distributed by AID through the Indian government to Pakistani refugees.

Convenience homemade bread has been improved through research. It is made from frozen dough that is thawed and baked at home.

Loss of yeast activity during extended frozen storage is the chief barrier to making good frozen dough. The yeast must be active for the dough to rise sufficiently high and rapidly after thawing.

ARS scientists have developed procedures for making improved frozen dough with two of the basic methods used in commercial bakeries: the straight dough method and the sponge-and-dough method. The quality of bread made by the straight dough method was improved by a combination of measures including aging the compressed yeast. Modification of the sponge-and-dough method was particularly successful. It yielded bread that had excellent volume even after extended frozen storage.

Frozen bread dough made with the new processing methods is available to consumers in some parts of the country.

San Francisco sourdough french bread may soon make its way into ovens all over the world.

For more than 100 years, this famous and delicious bread could be made only in the San Francisco Bay area. The cultures that give the sourdough bread its unique texture and flavor were a mystery.

Recently, agricultural scientists isolated the yeast and bacteria in these cultures. As a result, the sourdough process has been simplified by improving the way batches of dough are inoculated. Development of commercial cultures, which can be packaged and distributed like baker's yeast, would make San Francisco-type sourdough bread available anywhere bakers want to produce it. These sourdough cultures might also be used in other baked goods to give them a new flavor.

Air-dried mushrooms are a new product similar in flavor to the expensive freeze-dried mushrooms—but at about one-half the cost.

The elegant mushroom can now be dried and stored, yet retain the distinctive flavor and color for which it is famous. The air-drying process, developed by ARS researchers, yields a nutritious product that can be stored in hermetically-sealed packages for at least 7 months while retaining its flavor and color.

Better methods of preserving mushrooms are important because the fresh mushroom is a highly perishable product.

NUTRITIVE QUALITY OF NEW FOODS

A primary concern of nutrition scientists is to maintain or improve the nutritive quality of new foods developed in the laboratory. Adding nutrients is sometimes the way of accomplishing this.

Current research in nutrition seeks to answer:

- What nutrients are required for good health?
- What quantity of these nutrients is needed for each of the different age groups?
- In what forms are the nutrients usable by the body?

Research on iron indicates that only about 10 percent of this essential mineral occurring in foods on the market is absorbed by the body. To determine the absorption of iron in foods, scientists—in experiments with rats—have developed a system of measuring the usefulness of dietary iron sources compared with that of an iron supplement.

In a related study under ARS grant at the University of Washington, scientists are concerned with the usefulness of iron from dietary sources to both experimental animals and to man. The scientists are measuring the retention of

radio-labeled iron from a variety of foods fed to rats and comparing the results with similar studies of humans.

Many people, and particularly children, suffer from an iron deficiency. Nutritionists at Beth Israel Hospital in Boston are working with babies, trying to prevent the onset of iron deficiency anemia during the first 2 years of life by giving them iron-fortified cereals and iron-fortified milk or evaporated-milk formulas made with iron-fortified corn sirup. Results so far are inconclusive.

Chromium is another essential trace mineral. Evidence is accumulating that as people get older their ability to use glucose declines. Chromium is needed in much smaller amounts than iron but is essential in regulating the human metabolism of glucose (blood sugar). Scientists are trying to isolate large quantities of the chemical compound through which chromium regulates the use of blood sugar. They hope that someday this chromium compound can be added to foods that have lost chromium during processing.

Other trace elements under investigation are zinc, selenium, nickel, and vanadium. Nutritionists want to know what effect the processing of foods makes on the availability of these nutrients to the body.

To meet consumer demands, research is conducted continuously in Agricultural Research Service laboratories to produce new processed foods and to improve existing ones. Research must first determine human requirements for nutrients and then develop new foods that have the nutrients needed for good health and well-being.

Consumers benefit from this research. They are getting a large variety of convenient, processed foods of high quality and better nutritive value.

GREENER lima beans . . . higher protein wheats . . . salad-size tomatoes . . . thornless blackberries. All these, and more, are a result of agricultural science breeding research with plants. Through cross-breeding and breeding mutant varieties, agricultural scientists are creating foods for the consumer that are higher in vitamins and proteins, more abundant and available all year round, and are more eye-appealing and palatable. Though plant breeding research renders its primary service to farmers by helping to supply them with new and better crops that are hardy and have increased yields, the ultimate beneficiary of agricultural research is the consumer.

IN SEARCH OF NEW AND BETTER CROP VARIETIES

A basic step to breeding new and better crop varieties is to find new plant species with desirable characteristics that can be imparted to our domestic varieties. This is the job of plant explorers. These highly specialized plant scientists, trained in plant identification, plant geography, and ecology, continually search for primitive and cultivated plants to give to our domestic varieties disease and insect resistance, and qualities desired by consumers.

In any one year, ARS plant explorers bring about 9,000 new plants into the United States. This is a cooperative effort involving Federal, State, and private collaboration.

Once here, these new plants are tested to determine their crop or breeding potential. Only a few are selected as a potential breeding source for new or improved crop varieties. For those selected, scientists must then determine

how these new varieties can be propagated efficiently and in great numbers. The chosen varieties are then offered to various research breeding programs.

SEED — RES — 0 — 17
Technicians at the National Seed Storage Laboratory plant seeds on germination paper. Later the seeds will be placed in germination chambers in background.

SEED — RES — 0 — 18
Corn seedlings are checked for germination.

Successful recent introductions include large-fruited persimmons, the pistachio nut (a new industry for California), and the Chinese gooseberry. A cross of a wild tomato and a commercial variety that has resistance to skin cracking was recently introduced from Germany. A similar cross from New Caledonia helped to develop 'Summer Cherry', a high-yielding, "salad-size" tomato variety, having small, spherical fruits that resist cracking and puffing. Further, a wild tomato from Peru was used to develop high vitamin C varieties. Other outstanding introductions include such tropical fruit varieties as avocado, lychee, and mango.

Along with collecting new plant varieties for breeding experiments, a major goal of plant explorers during the next decade is to collect as many of the world's primitive and wild plants as possible to preserve our future food supply.

Everywhere the march of progress, especially in developing countries, is decimating plant communities. Bulldozers uproot valuable species in the building of towns, roads, factories, and airports. Dams drown ancient habitats. Goats graze many plants out of existance. Everywhere civilization is encroaching on wilderness and with it comes extinction of countless plant varieties that could have been used to revitalize those domestic plants that have become genetically weakened through in-breeding and over-cultivation. The germ plasm from these wild varieties may also carry genes for resistance to adverse weather conditions, insects and pests, and pollution. Scientists fear that —within only 10 years—much important uncollected germ plasm will be lost.

Since World War II, however, scientists have made great strides in perpetuating germ plasm. World collections of

major crops have been assembled, including several maintained by ARS. ARS maintains a living reserve of germ plasm at the National Seed Storage Laboratory, Fort Collins, Colo., where 78,000 lines of crop seeds are housed. This facility stands ready to replenish depleted working collections anywhere in the world. The scientific community is working hard to establish a global network for long-term preservation of germ plasm. These living reserves of germ plasm may well assure our food supply for the future.

NEW CROPS FOR NEW FOODS

Through the efforts of plant explorers and plant biologists, a near relative of collard and mustard greens, *Brassica carinata*, may one day become a tasty new leafy green vegetable for American tables. The flavor of these greens, when canned or frozen, is somewhat milder than collard greens.

ARS plant explorers found this plant growing as a vegetable crop in Ethiopia. *Brassica carinata* was brought to this country and successfully test grown by scientists at Texas A & M Lower Rio Grande Valley Research and Extension Center. ARS food technologists, working in cooperation with the Texas scientists, evaluated the greens and found them to be a good source of protein, minerals, including calcium, and lysine and other essential amino acids. For farmers, it will be an abundant crop; its yield is about 5 times that of spinach. Plant scientists are now working on ways to make this crop less stemy, in addition to evaluating where this vegetable crop can be most economically and successfully grown in the United States.

SEED — RES — 0 — 19

Foreign matter is blown away from grass seed, which is then placed in cans for storage.

Another new crop for Americans is the Chinese gooseberry, or Kiwi berry, a recent addition to produce sections of fruit markets across the country. Described as "beautifully ugly", this fruit is the size and shape of a hen's egg, and has brownish skin with a covering of short, stiff hairs. Its lack of beauty, however, is only skin deep. When peeled and sliced, it reveals an attractive green

FLOW — VAR — 15 — 2

Hybrid sunflowers have been bred to produce good yields of high-quality oil. (Photo by Harris Barnes, Jr.)

flesh that becomes a cream shade toward the center. Its flavor has been described as something different and delicious. Some say that it tastes like a combination of strawberry, rhubarb, and pineapple. Kiwis also offer more vitamin C than citrus.

The Kiwi berry was first introduced to this country from China and New Zealand by the U.S. Department of Agriculture in the early 1900's. During this time, New Zealand was beginning to develop Kiwis as a commercial crop. The fruit, however, did not become popular in the United States. Most of the vines that were established were not replaced when they grew older, and in one generation Kiwi all but disappeared from American gardens. (One of the few remaining plants from the early distribution is being grown at the U.S. Plant Introduction Station at Chico, Calif. It is about 40 years old.)

The revival of the Kiwi berry in this country resulted from its development into a commercial crop in New Zealand. Exports of Kiwi to this country from New Zealand have increased and the imported fruit is now being sold on the west coast and in larger markets in the East. Consumer acceptance has stimulated new interest in this plant as a potential crop for the western United States.

New test plantings are now being established in California to evaluate the adaptability, hardiness, and productivity of Kiwi on the west coast.

The sunflower plant, currently undergoing intensive study by agricultural scientists, may become a stable cash crop for some areas of the country. Sunflowers are hardy, adaptable plants, capable of producing a good, edible oil that does not easily become rancid.

Although a few U.S. farmers have grown sunflowers for oil, birdfeed, and

confectionaries, variations in plant height and time of maturity have made harvesting difficult and yield undependable. These variations result from open pollination—random pollination within any sunflower crop. Recently, an ARS agronomist working in cooperation with the Texas Agricultural Experiment Station discovered a gene in certain plants derived from wild sunflowers that can turn unpredictable open-pollinated varieties into predictable hybrid ones.

Through breeding, it will now be feasible to develop commercial hybrid sunflowers of uniform height and maturity with good yield, disease resistance, and high oil content.

IMPROVING NUTRITIVE VALUE

Recent emphasis on present and future world food problems has stimulated a great deal of national and international interest in the nutritional value of foods. The American consumer, for example, shows renewed awareness of the health benefits and the nutritive value of vitamins and high-quality proteins in human diets. To meet this challenge, plant breeding research strives to increase the levels of vitamins and proteins in vegetable and small-grain products.

Through breeding research, plant scientists have produced two cabbage selections with twice the amount of vitamin C as the standard cabbage varieties, and are working on ways to increase vitamin C in cantaloup.

Protein research is double-faceted. On one hand, scientists are trying to raise the overall level of protein in particular foods; and, on the other, they are trying to find out how to make this protein more complete and, therefore, more nutritious.

Food legumes—such as dry beans and peas, lentils, cowpeas, chickpeas, mung beans, and pigeon peas—constitute a very important protein source. They, nonetheless, lack enough in quantity of certain amino acids—namely methionine, cystine, and tryptophan—to provide a balanced high-quality protein.

Studies are underway to find germ plasm high in total protein for dry beans, dry peas, and lentils. These studies, by an ARS scientist in cooperation with the Washington Agricultural Experiment Station, Prosser, have resulted in the identification of certain lines and varieties of dry beans having 30 or more percent protein (average is 25 percent). This 5 percent increase in protein could have a significant impact on the nutritional value of beans.

Agricultural scientists are also endeavoring, through breeding, to lessen the gas-forming properties of dry beans following consumption, and to lessen certain substances, called anti-metabolites, found in some legumes that lower their nutritional value.

ARS scientists in cooperation with the experiment station at Prosser are using varieties of beans to study how protein is inherited. To do this, they are first trying to find out what makes protein content vary between different varieties and sometimes between plants of the same variety. To find the answer, scientists are crossbreeding bean lines of different protein content to determine the genetics of protein inheritance. Once the inheritance of protein content is uncovered, scientists may be able to "structure" balanced protein in many legumes, thus making them rich in high-quality protein.

Through breeding research, a new lentil variety, "Tekoa," has been developed with 17 percent more protein than standard commercial varieties. This len-

til, developed jointly by ARS and Washington State University College of Agriculture, also has a larger seed that is more uniform in size and color.

ARS scientists are also breeding for higher protein content in small grains. In a cooperative effort with the Nebraska Agricultural Experiment Station, 26 breeding lines of hard red winter wheats have been developed. The new wheats have 2 to 3 percent more protein than the standard commercial varieties.

These new lines were released to wheat breeders who will use the breeding stocks needed to develop better commercial varieties for wheat growers.

The problem of breeding for higher protein content in small grain is that there is always an accompanying reduction in grain yield. The first step, however, has been accomplished in rice breeding studies. ARS plant breeders have managed to develop some rice varieties that are 1 to 2 percent higher in protein while still giving fairly good yields. A goal, therefore, in breeding for high-protein small grains is to develop varieties that enable farmers to get profitable yields and consumers to get high-protein wheat products.

Until 5 years ago, oat grain quality was measured in terms of weight, plump clean kernels, and freedom from kernel damage. The discovery of high-protein content in *Avena sterilis,* a wild oat from the Mediterranean area, prompted research on nutritional quality. While this wild species produces low-grain yields and kernels unacceptable for marketing, it does contain 30-percent protein—the average protein content for standard commercial varieties is 17 to 18 percent. Plant breeders are now trying to determine whether this high-protein characteristic can be transferred to the standard oat varieties.

Someday, science may give us vegetables and small grains with protein content comparable to that of meat and dairy products.

MAKING FOODS TASTIER

Plant breeding not only helps to make foods more nutritious, but also better tasting. For example, ARS scientists are breeding certain sweet corn lines to combat the natural decline of sugar content after pollination.

In sweet corn breeding studies, scientists found that certain combinations of genes may preserve flavor and prevent deterioration during normal post-harvest handling. In these studies, sweet corn lines have been developed with increased sugar content. These will be used as breeding stock to develop improved commercial varieties.

The taste of tangelos is being improved through breeding. Nova tangelo, a new variety, was released to commercial growers. It has a higher sugar content and tastes sweeter than most other commercial varieties.

MAKING FRESH FOODS MORE APPETIZING

Physical characteristics, such as color and texture, are important in fruit and vegetable quality. Besides taste, consumers want fresh produce that looks good and feels good.

Many good tasting tomatoes are pink or orange-flushed. Most consumers, however, prefer tomatoes with a naturally red tomato color. To help meet this consumer demand, plant scientists are

TOM — CLP — 0 — 37

An increasing number of tomato growers are using machines for harvesting. ARS scientists have developed three varieties specifically for machine harvesting in the eastern and central States.

improving tomato color through breeding. Mutant types, such as 'crimson' and 'high-pigment' are being incorporated into adapted varieties. These mutants cause the tomato to ripen to a more lustrous red, thus improving its acceptability on the fresh market.

Fresh market potatoes are also being improved by plant breeders who are breeding potato lines that are low in total glycoalkaloids. Too much of these substances can impart a slight bitter flavor to the fresh product.

A new variety of dates has been developed through agricultural research.

This new variety, 'Medjool', is 2½ times larger than ordinary varieties besides being moist, tender, and very flavorful. This variety was found in Morocco by ARS plant explorers and was tested at the U.S. Date and Citrus Research Station in Indio, Calif. It has been widely accepted by commercial growers and is now on the market in California.

Other improved fresh food products developed by plant breeding and now available to consumers include:

- Watermelon that is redder and has better texture.
- Spinach that is darker green with excellent leaf texture.
- Blueberries that are larger and more flavorful.
- Lettuce that is firmer than the standard variety even under relatively warm temperatures—making it very suitable for hot-weather sandwiches and salads.

MAKING FRESH FOODS MORE AVAILABLE

ARS has developed spinach lines and varieties that makes it possible for fresh spinach to be produced in summer as well as other seasons. Normally spinach varieties flower in the summer, making machine harvesting impossible. These new spinach lines, which have a characteristic to prevent this flowering, have been bred to produce hybrids and varieties that are long-standing with improved leaf color and texture, better productivity, and more uniformity. The new varieties are now available to spinach producers.

Seven early ripening apple seedlings were selected and propagated for distribution and testing. These selections will ripen in July and August when fresh high-quality apples are not available, and when only stored fruit is marketed.

The 'Southland' raspberry holds promise as a new crop for the southern United States. Crossbreeding has resulted in this variety, which is adaptable to an area where raspberries could not be commercially grown before.

SOLVING CONSUMER PROBLEMS

ARS breeding research zeros in on food problems particularly annoying to consumers.

Some consumers will remember 1969 as a "bad lettuce" year. Head upon head of lettuce in supermarkets had ugly gray-green or brownish streaks up and down the ribs. That fall, at Brawley, Calif., ARS began research to find out why this disorder (internal rib necrosis) occurs. Scientists found that the disorder was associated with only one variety, 'Climax'; other varieties were not affected. They are working now to develop varieties as good as 'Climax', but that have built-in resistance to the disorder.

ARS is on the way to solving another problem that irritates consumers—cooking oils that develop bad odors and film when held at high temperatures for long periods.

Oil from a unique safflower variety, named UC-1, may be the answer. A few vegetable oils have natural stability under high temperatures, but they are more costly than processed oils. Among these, olive oil has the greatest natural stability.

UC-1 oil is similar to olive oil in chemical composition. In addition, safflower is a crop easily grown in many parts of the western United States. There is still,

however, one problem that prevents this safflower variety from catching on with the processors. It is that the seeds from this variety so closely resemble the seed from other varieties that, in harvesting and processing, they could get mixed up. If any seeds from ordinary varieties were mixed in with those from the UC-1 variety, and the unprocessed oil from the mixture was used in commercial cooking, the oil would probably become rancid rapidly and develop a film.

ARS scientists cooperating with a plant geneticist at the University of California may have found the key to successful marketing of the oil from the UC-1 variety. They are developing variants of UC-1 that have seed coats in a different color so that they can be easily distinguished from seeds of other safflower varieties. This breakthrough is important in making this new oil commercially feasible. In the future, french fries and many other fried foods will be fresher tasting and more delicious.

For pistachio lovers, who get frustrated with those hard-to-open shells, ARS research has developed a pistachio nut that is naturally split so that it opens more easily. It also is larger—about the size of a peanut. This new variety, 'Kerman', is providing a new crop for California.

For home gardeners who want to grow blackberries in their backyard but don't because of the annoyance of the thorns, scientists have developed a new thornless selection of blackberry, which produces berries that are firm and highly flavored.

MORE MEAT, BETTER MEAT... THROUGH BREEDING

AMERICANS are eating more meat than ever before. In 1970, the per capita consumption of beef, pork, lamb, and poultry was 236 pounds, or more than 10 ounces a day. In 1960, the per capita consumption of meat was only 195 pounds. The upward trend is likely to continue.

In most households, menu planning revolves around meat, and meat is the featured item on restaurant menus, as well.

Meat well deserves its central place in our diet, because it is truly a basic food. Along with milk, eggs, and fish, meat is our major source of protein—a very important nutrient.

The human body is largely made of protein; without protein life cannot go on. Muscles, skin, fingernails, internal organs, blood cells—all contain protein.

Meat is one of the most concentrated sources of high-quality protein. It has a good balance of the essential amino acids—building blocks of protein—that we must obtain from food. When some of these amino acids are inadequately supplied, our bodies can't make the best use of protein for growth and repair of tissues.

Meat also supplies iron, calcium, phosphorus, and B vitamins, especially thiamin, riboflavin, and niacin.

Animal scientists are learning step-by-step how to make meat animals measure up to the highest standards of quality, and to make more of all kinds of meat available at reasonable prices.

Breeding is only one of the methods agricultural scientists are using to achieve these goals. Feeding, management, and disease control are also important, but breeding is a fundamental approach to improving livestock and poultry.

Better feed and management can improve an animal's ability to produce

more and better meat only within the limits established by his inheritance. Genetic changes made by selection and breeding are stable, and can be passed on from generation to generation.

BREEDING ECONOMICAL BEEF

Beef is the most popular meat of all; nearly half of the meat the average American eats is beef. Making beef production a more efficient business is an important task for animal breeders.

In the end, it is the consumer who benefits from efficient production, because inefficiency means higher production costs and higher prices in grocery stores.

Efficiency involves factors that span the entire lifetime of cattle of both sexes. Tomorrow's beef cattle will have a higher birth rate, a higher calf survival rate, and a faster growth rate. Another objective is feed efficiency—more meat produced per pound of feed.

All of these traits can be inherited. Breeding, along with improvements in feed and management, will lead to future increases in efficiency.

While scientists are breeding cattle to be more economical producers, they are at the same time keeping a close watch on quality.

Efficiency and quality are not unrelated goals. The quality of the carcass—the slaughtered animal minus head, feet, and tail—is also highly heritable.

The ideal carcass is thickly muscled with a low percentage of bone and a high percentage of the more valuable cuts—rib, loin, rump, and round. The meat should be firm and a bright cherry red, surrounded by a uniform layer of smooth, firm fat. Marbling—flecks of fat interspersed in the meat—and a fine texture

indicate good flavor and tenderness.

Quality is influenced by age as well as by heredity. Consumers have shown a preference for the jucier and more tender meat that comes from younger animals. Steers used to be marketed when they were 3 to 4 years old; now they are marketed at 15 to 27 months.

Faster growth has made earlier marketing profitable. Production per beef cow has been increasing in recent decades, and carcass grades are averaging higher.

There is still opportunity for progress. Although the basic breeding techniques —selection and crossbreeding—are ancient, their potential is inexhaustible.

When breeders select only the best animals for breeding stock, the offspring improve with each generation. It sounds simple, but there is a long list of questions to be answered. How much variation exists within breeds? How do the effects of heredity and environment interact? Can trait A be improved without sacrificing trait B? What are the best ways to measure important traits?

In cooperation with State agricultural experiment stations, ARS is conducting a comprehensive program to answer such questions at research stations in Clay Center, Nebr., Miles City, Mont.,

ST–3978–5
ARS cowboy rounds up a Hereford bull at the Front Royal, Va., research station, where scientists are breeding cattle for improved productivity.

Fort Reno, Okla., and other locations.

Crossbreeding, in its simplest form, is the mating of a male of one breed with a female of another. In practice, the matchmaking is often more complicated. One or both parents may be crossbred, so that the calf may be a product of three or four breeds.

Crossbred livestock combine the characteristics of both parents, and may also exhibit hybrid vigor, or heterosis. When animals of different strains or breeds are mated, the offspring have a different assortment of genes, and the result is usually larger, more vigorous young.

According to ARS estimates, crossbreeding could eventually cut the total production cost of the beef industry by as much as one-fifth.

In 1967, only 5 percent of commercial beef cattle were crossbreds. The current percentage is estimated to be 30 percent, and is increasing as research makes the results of different crossbreeding combinations predictable in greater detail.

Researchers are testing crossbreeding systems that can be continued generation after generation without loss of hybrid vigor.

Heterosis has the greatest effect on reproduction and growth. Crossbred calves tend to be larger and to grow more rapidly. Crossbred cows are more fertile and bear healthier calves. Calves from these crossbred mothers have an advantage in nursing, because crossbred cows can usually provide more milk.

Crosses between beef cattle and dairy cattle could mean even greater improvement in the early growth of calves. A part-beef, part-dairy cow can supply bigger helpings of milk to her calves.

At the Range Livestock Experiment Station in Montana, calves born from beef bulls and Brown Swiss cows—a dairy breed—grew faster than calves born to beef cows and sired by the same bulls. The calves of the Brown Swiss cows were almost 14 pounds heavier at birth and had a higher survival rate.

Mothering ability is so important to the cattle industry that some day we may have breeds that are specialists in motherhood. Other breeds would then be developed as sire breeds.

The improved female lines would reach sexual maturity sooner so that they could bear calves at an earlier age. They would ovulate regularly, making artificial insemination more practical and permitting beef producers to take maximum advantage of top sires. The specialized cows would bear calves more frequently, and would rarely need assistance in giving birth.

Since most beef comes from steers (castrated males) the male lines would be bred for carcass quality, rapid growth, and efficient use of feed, as well as for greater fertility.

These are some of the directions of beef cattle research today.

BREEDING FOR LEAN MEAT

Today's shoppers are looking for meat cuts that are lean, with a minimum of fat to trim away. More lean meat means more protein and fewer calories per pound.

"Too fat" used to be a common complaint about pork. Thanks to a new kind of hog, pork is getting leaner.

The common breeds of swine were traditionally bred to provide generous amounts of lard. These so-called lard-type breeds were short and thick-bodied, with heavy jowls and a thick layer of fat over the back.

In contrast, meat-type hogs are long and trim. Strains of these modern, streamlined hogs now exist in all breeds. Meat-type hogs yield added pounds in hams, loins, picnics, and Boston butts, with a minimum of excess fat.

The characteristics that make hogs meatier are largely controlled by inheritance. Limiting a pig's feed is another way to keep him from getting too fat, but breeding for meatiness is more effective.

A long-term experiment at the Agricultural Research Center in Beltsville, Md., has shown that the best meat-type hogs can be selected for breeding by simply measuring the thickness of fat on the back of the live pig. Backfat thickness is measured by a metal ruler or an instrument called a "lean meter." These are easy to use and cause little discomfort to the pigs.

After 15 generations of selection, a line of Duroc hogs bred for low backfat thickness yielded an extra 8 percent of lean cuts and 32 percent less fat than an unselected control line.

Use of artificial insemination is likely to increase the numbers of meat-type hogs. Until recently, artificial insemination of swine was limited by the lack of an effective method of storing boar semen.

Now ARS scientists have developed improved methods of evaluating semen in the laboratory. As a result, successful freezing and storage of boar semen has been achieved by scientists of ARS and the University of Minnesota.

Beef breeders would like to follow the lead and breed meat-type cattle. It is possible to genetically alter the conformation of beef cattle to provide more lean meat and more of the cuts popular with consumers.

To study the potential of such a breeding program, researchers have thoroughly analyzed the carcass data of several generations of straightbred and crossbred cattle.

After only one generation, the total production of retail cuts increased almost one percent. Fat content decreased by the same percentage. These results indicate that a breeding program to increase the amount of lean meat in beef cattle would be worthwhile. Measuring backfat thickness is proving to be a successful selection technique.

Since many consumers are looking for leaner beef, dairy cattle may be supplying a larger proportion of beef cuts in the future. Dairy cattle are naturally leaner than beef cattle. Meat from dairy cattle has long been used in processed meats and hamburger, but improvements in quality could give it a more favored spot in grocery meat counters.

Dairy meat often has too little fat to be as juicy, tender, and flavorful as consumers expect beef to be. Some inheritance from beef cattle could change this.

In feeding trials at Beltsville, Md., the dairy breeds performed surprisingly well compared with beef breeds. Holsteins, our most common dairy breed, made the fastest gains of any of the breeds. They also had the largest rib-eye area, the meaty portion of a rib cut.

The meat from Holsteins was less tender than the meat from beef breeds. Another dairy breed, the Jersey, had meat that was just as tender as that from beef breeds.

STEPPED-UP REPRODUCTION

Through breeding, ARS scientists are increasing the reproductive rate of animals. The most dramatic successes are being achieved with sheep.

ST–3537–13
Meat cutter saws loin chops from three lines of Duroc hogs: low-fat (left) and high-fat (right). Center cut is from a control line not bred for fat thickness.

A type of sheep called "Morlam" (more lambs) could make lamb more plentiful in every season.

Morlam ewes are bred in any season instead of only in the fall. Sheep are generally bred in September, October, or November. The lambs are born about 5 months later, in early spring. Since lambs need to nurse for only 2 months, ARS scientists reasoned that a reproductive cycle of 6 to 8 months should be possible. Shortening the cycle would lead to considerable saving in the cost of raising lambs for meat.

The key was to find rams and ewes that could naturally breed out of season. Breeds and individuals vary in this ability. After about 10 years of selective breeding, most Morlam ewes have lambing intervals of 6 to 10 months, rather than 12.

Scientists also hope to develop strains of sheep that will give birth to more lambs at a time. Most lambs are born singly or as twins.

A breed imported from Ireland is providing the answer. The Finnsheep breed normally gives birth to two to four lambs, and litters as large as eight have been reported.

Lambs born from crosses of Finnsheep with our domestic breeds are vigorous and healthy, but multiple births do cause a few problems.

BN–33642

Two sets of twin lambs were born to this Morlam ewe only 8 months apart.

Ewes carrying twins or triplets require extra care and need more assistance at lambing.

To determine which ewes will have multiple births, ARS scientists are using an ultrasonic scanner. Echoes of high-frequency sound bounce off the fetuses and show up white on Polaroid film. Separating these ewes from the rest of the flock so they can receive special attention could save sheep producers millions of dollars a year in feed costs and dead lambs and ewes.

Another problem is that the ewes don't always have enough milk to feed the extra lambs. A cow's milk formula—served ice-cold to discourage overeating—has been very successful in raising lambs separated from their mothers. Even some of the weakest lambs have pulled through on the cold milk.

POULTRY BREEDING GONE WILD

Crossbreeding has taken a new turn in poultry breeding. Crossing different breeds and strains of livestock is nothing unusual, but poultry scientists are trying out crosses of chickens and turkeys with pheasants and Japanese quail.

Poultry breeding is the most advanced area of livestock breeding. Genetic improvements in poultry have proceeded at a faster pace than improvements in beef cattle, sheep, and swine. Chickens and turkeys are easier to experiment with because they are relatively small, have a high reproductive rate and a short generation interval, and don't consume large amounts of feed.

Breeding practices that are being tested with beef cattle, sheep, and swine are standard procedure in the poultry industry. Nearly all broiler chickens, for instance, are produced by crossing separate male and female lines bred for different sets of characteristics. Artificial insemination is widely used in turkey reproduction.

To poultry scientists at the Agricultural Research Center, incorporating wild geese into domestic fowl seemed to be the next step. The first cross between domestic and wild fowl was between a chicken and a quail. The result was a bird smaller than a chicken but larger than a quail, intermediate in most characteristics between the parents.

Now pheasants have been crossed with chickens, turkeys with pheasants, turkeys with quail, and chickens with turkeys.

At this stage, the scientists directing the studies are more interested in basic research in genetics than in developing new products for the market.

The biggest obstacle in making crosses wider than interbreed crosses is that the offspring are usually sterile. So far, scientists have not solved this problem. They hope to breed male birds in the future, however, that will have viable sperm.

It is too early to make any predictions, but continued selection and crossing could result in a successful market bird with a new taste.

BREEDING BY COMPUTER

Nothing can take the place of experimenting with live animals, but animal scientists at the Agricultural Research Center and other locations have developed ways to do some of the work with high-speed computers.

The computer method is called "Monte Carlo" because it simulates the random, or chance, genetic processes involved in breeding.

"Monte Carlo" can "produce" 10 generations of swine in minutes instead of years. If the effects of a computer breeding program are averaged for several lines of descent, the results come close to the results achieved with live animals.

The "Monte Carlo" technique is not limited to swine breeding. Because breeding experiments with live animals involve a certain amount of risk, time, and expense, "Monte Carlo" can be used to make a preliminary appraisal of a proposed experiment. From the computer results, scientists can decide if it would be worthwhile to go ahead with a "real" breeding program.

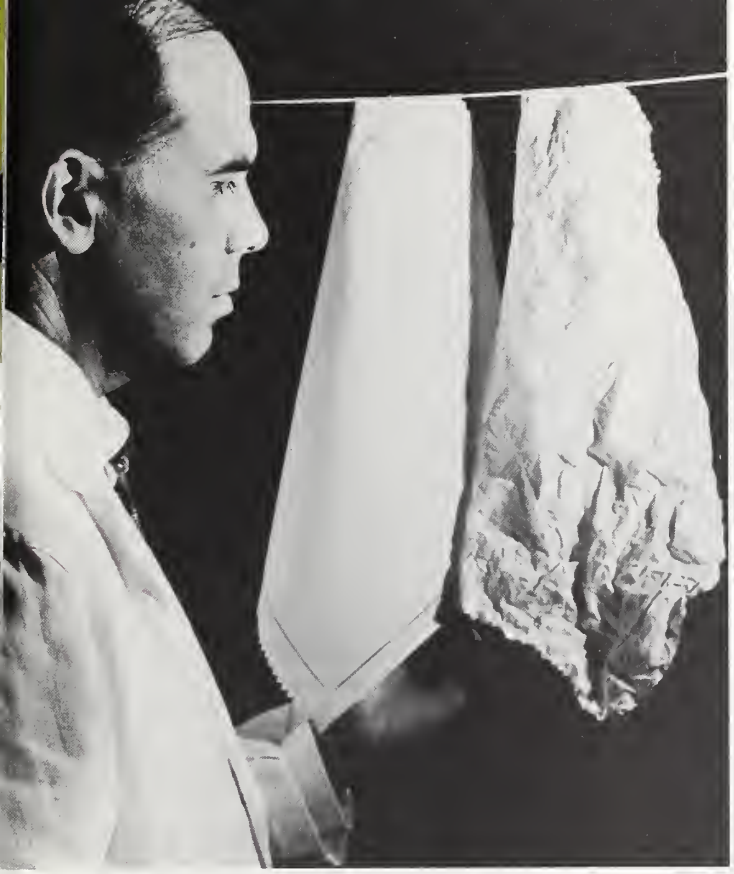
AGRICULTURAL scientists are building added consumer convenience into cotton. They are developing new and improved treatments for natural cotton fiber—treatments that give cotton more consumer appeal.

For centuries cotton has been a familiar fabric, but it has been losing ground to the synthetics because of their convenience and easy-care characteristics. Our scientists and the cotton industry believe that consumers will "go back" to cotton if it is modified to fit into today's high-speed life style.

Wash-wear finishes that reduce wrinkling and save on ironing, for example, have made for more carefree cottons. Stretch cottons that "give" without tearing are particularly appropriate for sportswear. Dresses, sleepwear, foundation garments, slips, and lace also benefit from built-in stretch.

Some of the innovations from this research are:

- Durable-press apparel that keeps its creases after many launderings—and that resists abrasion.
- Flame-resistant cotton goods that retain their flame resistance after repeated washing.
- Stretch-cotton fabrics and yarns that have greater tear strength, warmth, and wrinkle-resistance.
- Cotton canvas (for such items as awnings, tents, and tarpaulins) that is strong, and does not fade, stain, or rot from mildew.
- Water- and wind-resistant cotton fabrics (for rainwear and tarpaulins) that can stand up to mildew, rot, and harsh weather.



PN–1759
A chemist compares durable press cotton fabric (left) that has dried on a line wrinkle-free after spin-dry cycle in washing machine, along with its untreated counterpart.

CREASES THAT WON'T QUIT

Durable press is an innovation that has won wide acceptance with American consumers. When production of durable-press apparel began in 1964 it was limited to slacks, work pants, and sport shirts. Now, a billion yards of the durable-press fabric, a mixture of polyester and cotton, is annually processed into clothing of all descriptions, and into bedspreads, tablecloths, and draperies.

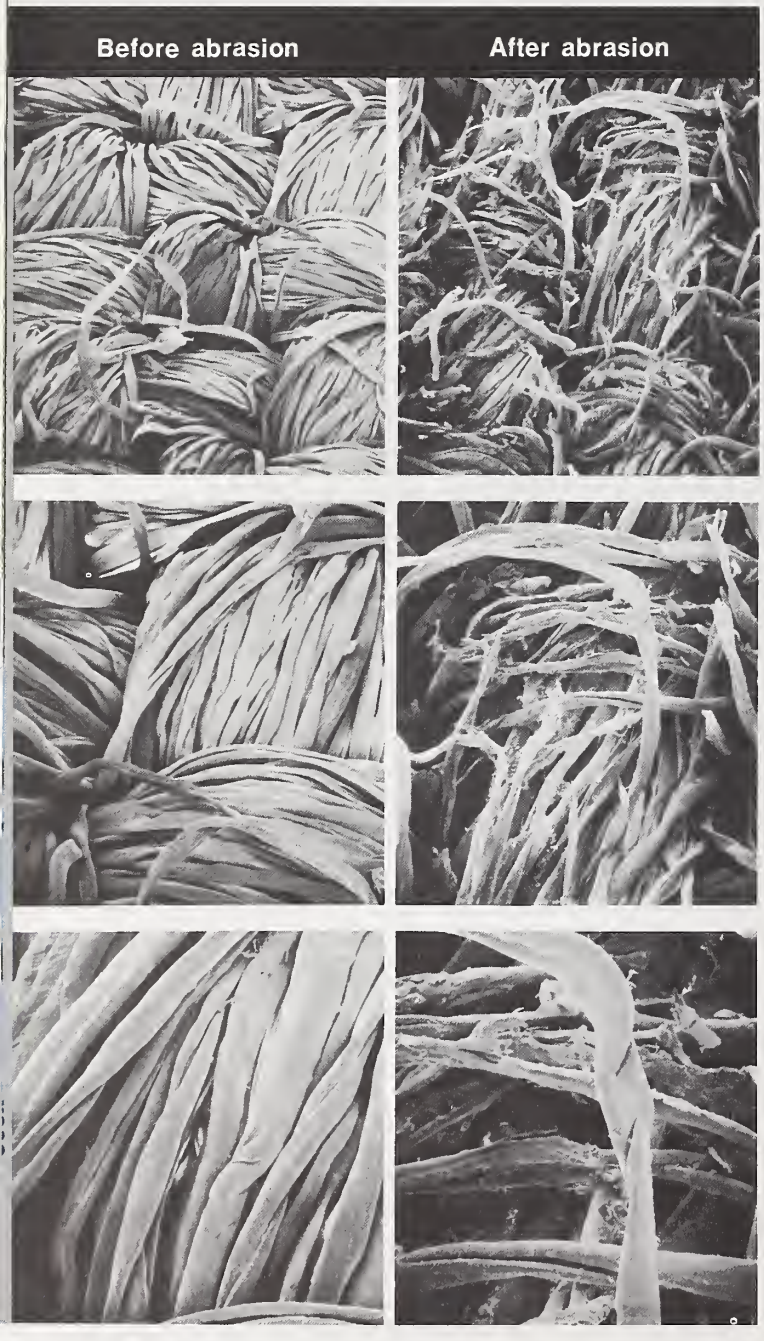
Moreover, the durable-press apparel of today is almost chore-free: Research has assured that garments remain smooth and wrinkle free, that creases stay in trousers, pleats stay in skirts, and seams lie flat—all without the chore of ironing or the expense of commercial

laundering. The crosslinking of cellulose molecules in cotton is largely responsible for these desirable features.

However, problems still remain. The treatments used to impart wrinkle resistance and smooth-drying characteristics tend to weaken the cotton in fabrics and cause them to wear out faster. Researchers are improving fabric finishing techniques to lengthen the wear life of treated cotton and polyester-cotton garments. Scientists found, for instance, that stretching plied cotton yarns before applying a wash-wear finish to them makes the yarn stronger.

The resistance of cotton fabrics to abrasion is being improved through the use of selective fabric structures, polymers (such as silicone and urethane) that coat the surface of the fiber, and a combination of these and other treatments.

USDA scientists are currently investigating a durable-press treatment for cottons—using organic acids as catalysts—that could result in fabrics that can be creased and uncreased at will by ironing. This will make it easier for tailors to alter durable-press garments and for home dressmakers to work with the fabrics. Creases are ironed in the fabrics after they are made wrinkle resistant, and these creases remain sharp after many launderings.



PN–1922
A piece of durable-press cotton fabric is seen through a scanning electron microscope (SEM) under three magnifications. SEM offers researchers a detailed observation of fabric surfaces. At (left) is the fabric before abrasion; (right), after 90 abrasion cycles.

LINE-DRYING COTTONS

A recently developed chemical finishing process for durable-press cotton garments imparts to cotton fabric the capacity to dry smoothly when hung on a line while damp—even after the spin-dry cycle in the washing machine. The new finish, known as the "mild cure process," gets its name from the relatively low heating, or curing, temperature involved.

COTTONS THAT WILL NOT BURN

Efforts to develop better flame-resistant finishes for cotton textiles have been intensified because consumers are becoming more concerned about safety. Fabrics that catch fire kill approximately 3,000 people each year and cause injury to 150,000 more.

Congress passed legislation covering flame-resistant materials in 1953, and strengthened those laws in 1967. This legislation—The Flammable Fabrics Act—set mandatory standards on all wearing apparel. In 1970, the proposed flammability standard added children's nightgowns, pajamas, and robes to the list of garments that must be fire retardant. The 1970 standard will be fully enforced by July 30, 1972; sleepwear failing to pass flame-proofing tests 1 year after that date will be banned from the market.

Agricultural researchers have pioneered in imparting flame resistance to cotton fabrics. In 1953, an ARS scientist was responsible for discovering a THPC fin-

BN–35352

Flame-retardant chemicals are helping to save lives. Doll's cotton dress treated with THPC flame-retardant finish (right) does not ignite when touched by lighted candles. Untreated dress (left) bursts into flame.

ish. This chemical formulation is now used in many parts of the world as a flame retardant for clothing. Much of the durable flame-resistant cotton fabric produced in this country contains THPC.

THE CHAR THAT PROTECTS

Fabrics treated with THPC have an outstanding characteristic: When held in a flame, they form a tough black char, which retains its fiber structure and strength. This char both protects and insulates.

Cotton is one of the few fabrics that forms a flexible char after being treated with THPC. Even applying a blow torch to the char of cotton fabrics will only cause this char to glow, and will not penetrate its protection. This treatment is saving lives today, and will help avert future tragedies.

Better flame-resistant materials for special uses are rapidly being developed by ARS scientists for both industry and the consumer. Children's Halloween costumes are being treated with fire-resistant finishes. Suits having built-in fire resistance with a new hard-wearing finish are worn by some firemen and industry workers in hazardous jobs. Flame-retardant cottons are being used in hospitals for cubicle curtains, for thermal blankets, and for gowns and sheets in operating and patient rooms where oxygen is administered.

Scientists are coping with questions about flame-retardant cotton apparel and household fabrics that need answering: How can they keep flame-resistant finishes from being lost during laundering? How can they prevent finishes from reducing strength in fabrics? How can they prevent retardants from stiffening fabrics? How can they reduce the cost of flame retardants?

Scientists are determining the durability and effectiveness of cotton garments treated with commercial and experimental flame retardants under home laundering conditions.

Twills, sateens, flannelettes, and other cotton fabrics treated with new THPC resins have shown promise as materials that will hold up during home laundering. Wrinkle and mildew resistance has been built into these new flame-resistant fabrics.

Researchers are developing three new durable flame-resistant finishes for cotton fabrics: one imparts a high degree of flame resistance to sateen and print cloth fabric. Another finish, when applied to a variety of cotton fabrics—commercial uniforms, aprons, nightwear—keeps them strong despite repeated laundering and drycleaning. A third treatment can be applied to most cotton fabrics, including children's sleepwear, without reducing the strength of the fabric.

In addition, a flame-resistant finish for cotton batting has been developed. This finish is giving cotton batting a new life in the automotive, furniture, and bedding industries.

The search for effective flame-resistant finishes for cotton is far from ended; in fact, the research effort toward developing new advances has never been greater.

CONSULTANTS TO RESEARCH

Biometricians who are available as consultants are aiding research scientists conducting cotton investigations. These specialists in statistics assist researchers by analyzing research data to

verify the credibility of an experiment, and make predictions or projections.

Working with an agricultural scientist, a biometrician recently developed the theoretical background for a technique that could be used to measure the length of cotton fibers. The data the biometrician furnished contributed to greater textile mill efficiency.

COTTON WITH STRETCHABILITY

Stretch cotton products are—like wash-wear cottons—a major breakthrough in cotton processing. Shirts, shorts, and summer suits that "give" without bagging, and cotton laces that have a "sculptured" look as well as stretchability, have been developed for American consumers.

Stretch cottons are a reality because of a treatment developed by ARS scientists—slack (or tensionless) mercerization.

This treatment is now being used by a number of commercial finishers to give stretch to all kinds of woven and knit cotton products. These stretch fabrics generally have increased comfort as well as being both wrinkle and abrasion resistant. The treatment changes the appearance of the least expensive laces, and makes them look richer and heavier.

Slack-mercerized stretch fabrics can be molded into articles of three-dimensional shapes: upholstery, furniture covers, and similar items. This can be done at a reduced processing cost, and with improved quality.

Researchers are working to combine the quality of flame resistance with stretch. Results are promising. Four different stretch cotton fabrics—two plain weaves and two twills—have been made

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This Oscar de la Renta "milkmaid" costume is made from cotton fabric treated by ARS scientists for wash-and-wear and wrinkle resistance.

flame resistant. These fabrics retained their stretch qualities. Researchers also discovered the flame-proofing treatment actually gave the fabrics good wash-wear characteristics.

OUTDOOR FABRICS

Awnings and tarpaulins that fade in the sun . . . become discolored by mildew . . . and rapidly deteriorate are problems that largely belong to the past. Agricultural researchers now are working to develop new and better weather-resistant finishes for outdoor cottons, and new curing and dyeing techniques as well.

In recent years considerable research has been conducted on outdoor fabrics because of the enormous amount of cotton used in awnings, tents, tarpaulins, car and boat covers.

Once, natural vegetable oils were used as a binder in most awning coating compositions. But investigations proved them unsatisfactory: they were susceptible to mildew when exposed to weather. Various synthetic resins were tested as coatings and found to be superior to natural oils. Now, these synthetic resins are widely used in the canvas industry.

Agricultural scientists are searching for—and finding—ways to extend the useful outdoor life of cotton canvas. They are impregnating canvas with aminoplast resins instead of coating it. They have found that the amount of weather resistance in canvas largely depends on how much resin is used, and to a certain degree, upon the curing method employed.

Aminoplast resins protect print cloth and duck cloth from mildew, rot, and sunlight. Resins that are catalyzed by a substance called zirconium acetate produce especially weather-resistant fabrics.

New curing techniques are being examined to give outdoor fabrics weather and rot resistance and yet leave them strong and durable. The fabrics usually deteriorate when heat-cured at a high temperature. ARS scientists solved this problem by drying the fabric at a relatively low temperature, and then storing it at room temperature for varying time intervals.

Another way researchers are building fabrics that can stand up to weather is by dyeing them with special minerals. Chromic chloride, iron sulfate, or chloride are some of the mineral dyes that are used to toughen outdoor fabrics for the consumer.

LONG-WEARING APPAREL

Hard-wearing, ARS-designed fabrics that have a durable press finish, unusual strength, and wash-wear qualities, will soon be offered commercially to consumers. For example:

- Work trousers of all-cotton twill have more durable creases; they have been given a resin-polymer durable-press finish that makes the fabric resistant to abrasion. The fabric, an ARS innovation, requires no ironing. A retail chain of 1,100 stores will soon establish a line of these hard-wearing work trousers.
- Durable-press seersucker suits for men, moderate in cost, and requiring no ironing, are now being marketed . . . the result of fabric research by agricultural scientists.

Woven from mercerized cotton yarn, these seersucker suits are designed with smooth-drying, crease-retentive, and wear-resistant qualities. Researchers

found that after thirty test launderings the trouser cuffs of the suits showed little wear.

The seersucker material is being marketed in durable-press slacks, as well as in ladies' and girls' dresses. The colors are white, white with gray, blue, rust, and green.

Using the principles learned from research on clothing fabrics, scientists will focus next on household goods such as sheets and drapes.

DISCOUNT COTTONS

The shortage of long-staple cotton, caused by lower production in recent years, stirred interest in using discount cottons.

Discount cottons are defined as fibers that are shorter than one inch, and cottons that have a very high or very low micronaire reading (a measure of fineness).

Researchers discovered they could blend discount cottons—including off-white, spotted cottons—and spin highly acceptable yarns and fabrics. The blending procedures used for discount cottons are the same as those used for blending cotton fibers with synthetic fibers.

Yarns woven from discount cottons are currently being woven into many types of fabrics. By expanding the demand for discount cottons in the United States, consumer costs should be reduced for a variety of cotton items.

WATER- AND WIND-RESISTANT COTTONS

Raincoats that keep their water repellency . . . ground covers that protect a baseball diamond . . . tents that keep their inhabitants bone dry during a rainshower . . . sailing togs that shed water and oil equally. These are the products of agricultural research on weather-resistant cotton fabrics.

Scientists have been experimenting with chemicals called fluorocarbons to make cotton fabrics both water repellent and stain resistant. The new fluorocarbon finish developed by ARS—unlike finishes for cotton now on the market—will permit home laundering in ordinary detergents. Moreover, the new finish will last the life of the fabric.

This development will enable consumers to wear cotton raincoats that remain water-resistant after repeated machine washings. It also will enable yachtsmen to don sailing togs of 100-percent cotton that repel both water and oily stains.

ARS researchers have developed a lightweight cotton tarpaulin woven so densely that it is naturally water resistant without the need for a chemical finish.

The extra-dense tarpaulin—useful for both canvas goods and apparel—is the result of a high-pickage loom attachment developed by ARS researchers. The loom attachment enables the loom to weave fabrics with a greater number of threads per inch than is normally obtainable; these fabrics are lightweight and yet have sufficient density to make them both water- and wind-resistant without the need of any chemical treatment.

The Department of Defense is interested in dense-cotton fabrics for tents, rainwear, and flight clothing. These fabrics also have attracted the interest of the automotive industry, and canvas goods manufacturers because of their ability to stand up to weather.

With new fabrics and new finishing treatments, agricultural researchers are giving cotton added qualities that consumers will continue to enjoy in the future.

EASY-CARE WOOLENS

TODAY'S woolen fabrics are good looking, soft, comfortable, relatively soil resistant, and easy to clean and tailor. They also are partially flame resistant. Nevertheless, synthetic fibers have become increasingly popular because they have many characteristics that appeal to consumers. Besides being easy to care for (quick washing, drying, and ironing), they resist shrinkage, moth damage, and prolonged wear. Because of these characteristics, many people prefer synthetic to woolen materials.

To give wool more qualities that consumers like, ARS scientists have developed new knowledge about wool and new methods to improve it. Some of these methods are crossbreeding sheep for longer wool fibers, chemical shearing of sheep, and such chemical treatments of woolen fabrics as mothproofing and shrinkproofing.

CROSSBREEDING FOR BETTER WOOL

Researchers have found that crossbreeding sheep carrying many unlike genes can improve such economically important fleece traits as longer wool fibers and more usable wool. Any improvement in wool production that results from cross-breeding is passed on to the consumer in more desirable and less expensive woolen products.

Research is continuing, and as more information is developed, the practical application of crossbreeding to produce wool more efficiently may be possible. When this happens, both producers and consumers can benefit from the increased production of higher quality wool and better woolen fabrics.

CHEMICAL SHEARING

Chemical shearing of sheep promises a way to help wool producers meet the shortage of skilled sheep shearers and at the same time reduce the cost of wool production. Shearing with chemicals can be done by unskilled workers at a fraction of the pay for experienced shearers. Cyclophosphamide (CPA) is the chemical currenty used by research scientists and it shows promise as a practical defleecing agent.

CPA could help improve the quality of wool by preventing the short fibers that result from second cuts. (Second cuts are made by shearers to remove all the wool from the sheep.) Chemical shearing will also eliminate the cost of shearing equipment. All of these savings to producers may benefit consumers by holding down prices of woolen goods.

CPA interrupts the cell growth in the bulb of the wool fiber, causing a narrow constriction. The constriction moves up from the bulb as the fiber grows and in 10 to 12 days reaches a point just below the skin surface.

At that point, the fiber breaks easily and the whole fleece can be separated at the skinline, leaving the sheep completely bare. By grasping a handful of wool and rolling it back, a worker can defleece a sheep quickly and systematically without strain on himself, discomfort to the sheep, or waste of wool. Because of the bare skin, the sheep must be protected from sunburn or cold until new growth appears.

CPA can be administered orally or intravenously. If the dosage can be regulated so that removal of the wool can be delayed until a short new growth appears below the constriction line, sun-

ST–4033–9

A technician removes wool easily by rolling his wrist along the skin of a sheep treated with CPA.

burn and cold will not be a problem.

The likelihood that chemical shearing will reduce the costs of producing wool promises to benefit both consumers and producers.

MOTHPROOFING WOOLENS

Estimates of damage in the United States from insects that feed on fabrics range from $100 million to as much as $350 million annually. To protect consumers against such damage, inexpensive and safe mothproofers are needed.

The easiest and most effective way to protect wool clothing, rugs, blankets, and other items against fabric insects is to have them treated with a moth resistant compound. The simplest way of getting this built-in protection is to buy items treated for moth resistance.

Intensive effort has been directed toward research on mothproofing. Of the large number of chemicals claimed as mothproofing agents, only three or four have been used extensively. For a number of years the most commonly used mothproofing agents have been chlorinated hydrocarbon insecticides.

There is now renewed concern among consumers for the development of new mothproofing compounds to replace the chlorinated hydrocarbons. In response to this concern, ARS scientists have intensified their mothproofing investigations and evaluated several hundred compounds. The research is directed toward the investigation of compounds with low toxicity to mammals.[1]

The researchers have found that a class of insecticides known as the organophosphates show promise for development as mothproofers. Two of the most promising are Ciba C-9491 and Gardona.[2]

Results of the tests show that Ciba C-9491 will protect woolens against black carpet beetle damage before the cloth is cleaned, after three drycleanings, and after 12 months of aging with no cleaning. Protection became poor after two washings. This compound shows more promise for development as a protectant for woolens that are drycleaned rather than washed.

In the past, studies with Gardona showed that it might make a good home-type mothproofing treatment for washable woolens. In later studies, it was applied to 100-percent woolen cloth in a drycleaning solvent during the rinse cycle and in an emulsion bath from a laboratory padding machine similar to the machines used by textile manufacturers to apply dyes and fabric finishes. The results showed that it satisfactorily protected the cloth against damage by the larvae of the black carpet beetle.

Gardona appears to be better adapted as a protective treatment for woolens in storage than as a permanent-type mothproofer that would be resistant to washing and drycleaning. Tests showed that Gardona can protect woolen cloth for 3 years of aging without washing or cleaning.

Another promising mothproofer is a synthetic pyrethroid-type insecticide

[1] This publication reports research involving experimental pesticides for both home and commercial uses as mothproofing agents. It does not contain recommendations for their use, nor does it imply that they have been registered for the uses discussed here. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

[2] Trade names are used in this publication solely to provide specific information. Mention of a trade name does not constitute a guarantee of the product by the U.S. Department of Agriculture nor does it imply an endorsement by the Department over comparable products that are not named.

called Penick SBP-1382. This compound is of particular interest because of its resistance to removal from cloth by cleaning and its low toxicity to mammals.

Studies are also being made of a class of antiseptics known as quaternary ammonium (QA) compounds. Because QA compounds are widely used as gargles and for dishwashing, it was felt they should be safe mothproofing agents.

Twenty-one QA compounds were tested on wool for damage by the larvae of the webbing clothes moth and the black carpet beetle. Initially, two of the compounds were selected for studies of their practical application. They were tri

FABR — RES — 0 — 4
A scientist tests wool to determine if light of various intensities causes mothproofing agents to become ineffective.

(octyl-decyl)-methylammonium chloride and hexadecyl-pyridinium chloride.

These compounds were applied by rinsing the yarn or fabric in solution or by spraying or padding finished cloth. A procedure also was developed for application in a home washing machine.

The tests showed that tri (octyl-decyl)-methylammonium chloride is an effective mothproofer for wool. Based on its adaptability to various methods of application and durability to both washing and drycleaning, the compound was found to be the most suitable of the QA compounds tested for commercial application. It also was found to be a promising home mothproofing treatment for washable woolens.

WASHABLE WOOLENS

Research to develop washable wool fabrics began several years ago to satisfy the demands of consumers. The research approach was to find out why wool shrinks and then learn how to prevent it. The scientists knew that wool lends itself readily to chemical modification, which caused them to believe it would be possible to change wool chemically to meet the demands of the mills and consumers.

The surface of wool fibers is covered with overlapping scales all pointing in one direction. When wool fiber is wet it softens. As the fibers slide along each other, they entangle and are held that way by the scales.

If the scales could be smoothed or a coating applied to cover them, the fibers might slide back to their original position. The need was for a coating that did not change the softness of the fibers and one that would stay on the fabric through wear and washing.

Polymer chemists suggested that interfacial polymerization might work. This is a chemical process that brings together two chemicals in solutions that do not mix. The chemicals react at the interface of the solutions to form an insoluble polymer, with characteristics different from the original two soluble chemicals.

The scientists experimented with many chemicals that could be used to form polymers. They found that when wool fibers were coated with one of these chemicals and then dipped in another, a polymer formed on the wool fibers. The result was that the scales were covered with a thin permanently anchored layer of a nylonlike material. This coating allowed the fibers to slide back easily to their original position as desired by the researchers.

The new process was named WURLAN, a word coined from the initials of the research laboratory where it was developed. WURLAN was widely used by manufacturers and it suited the needs of consumers.

However, cheaper chemicals have been found and processing methods have been greatly improved. The WURLAN treatment used a chemical known as polyamide polymer. ARS chemists now have developed a new treatment using polyurea.

The polyurea polymer provides more effective shrinkproofing, softer treated fabrics, easier processing controls, and lower chemical costs than polyamide polymer. These advantages have provided increased benefits for consumers in convenience and lower maintenance costs of washable woolen garments.

Knitwear presents a more difficult problem than woven fabric because the knit structure is comparatively loose. Yarns in the knitted loops tend to shift and adjust during washing. This causes what is called relaxation shrinkage even

371X222–11
These samples of treated and untreated wool fabric show that treated woolens can be washed without danger of shrinking.

when the yarn itself is shrinkproof.

Fibers in knitwear tend to work loose and cause fuzziness. Sometimes, in washing, the loose fibers roll together in little balls. Most washable knits must be hand-washed or machine-washed on the gentle cycle to keep the little balls from forming.

ARS scientists have developed a process that allows knitwear to be machine-washed on the regular cycle. As soon as a commercial process is developed, manufacturers will be able to provide consumers with a wider choice of washable knit garments.

A further development in the treatment of woolens is an experimental shrinkproofing treatment in which wool yarn spends about one-half second in an elec-

trically excited gaseous medium similar to that inside a neon light tube. This process opens the way to the use of electricity instead of solvents to make wool shrinkproof.

Knit fabrics made of yarn treated in this way have high and durable resistance to shrinkage after repeated launderings. Another advantage is the treating equipment can be attached directly to a knitting machine. The process is called a cold-plasma treatment.

A plasma is a volume of gases at a low pressure in which the molecules are excited, or energized. The wool fibers are passed through the plasma to modify them. The energy source for a plasma can be heat or electricity, but if low temperature is required as it is for wool treatment, the energy source must be electricity.

After researchers determined that cold-plasma treatment prevents fabric shrinkage, they began working to design an apparatus that would allow continuous rapid treatment of wool yarns. The most recent development in cold-plasma research has been the development of a simplified, nonstop process that does not require the bulky vacuum equipment needed earlier.

Another experimental electrical device to modify wool is the corona reactor. The corona treatment modifies wool fibers when they are passed through energized gases at atmospheric pressure between two electrically charged plates.

Under proper control, corona treatment improves fiber processing efficiency. It does not change fiber tensile strength, fabric durability, or fiber color. Although fabric made from treated fiber feels slightly more harsh to the touch, this can be overcome by chemical treatments.

The cost of corona treatment in a commercial plant would depend on the scale of treatment. Estimates are that aside from cost of equipment, treating costs would be less than a cent a pound. Although corona treatment of fabrics is not new, ARS scientists are learning new things about its use on wool.

The addition of chlorine to the air and operating at high temperature speeds up the wool modification process about 10 times. This improvement makes the treatment promising for practical commercial application.

FLAME RESISTANT WOOLENS

Natural wool is highly flame resistant but this quality needs improvement to meet the stringent specifications set up for some uses, such as upholstery used in airplanes. For these uses, it is desirable to treat wool for durable added protection against flames.

Such a flame-resistant treatment for wool is under development by ARS scientists. The treatment does not affect color or tensile strength and does not seem to damage the desirable properties in wool, such as softness. Treated wool chars but does not melt or ignite, and it remains flame-resistant after dry cleaning.

The treatment consists of reacting the fabric with the chemical *bis* (*B*-chloroethyl) vinyl phosphonate. It can be applied to wool in any physical form from raw wool to woven or knitted fabric. Scientists are not sure yet whether it can be used along with other chemical treatments such as those used for shrink resistance, but research is continuing.

PERMANENT PRESS WOOLENS

A durable press treatment for 100-percent wool garments is under development by ARS scientists. It involves a two-step finishing operation.

The first step of the process involves treatment with a new chemical to stabilize the fabric before it is made into a garment. Stabilization gives the fabric the properties necessary to hold its shape. The garment is then made from the stabilized fabric.

In the second step, the garment is sprayed with a solution containing a setting agent. The garment is then creased, pressed, and cured in an oven to permanently fix its shape. Basically the process is the same as for setting hair.

A treated garment holds its durable press through many launderings and tumble dryings. If the process is found to have commercial application, it will meet another consumer demand for washable, permanent-press woolen garments.

IMPROVING TEXTURE

When a consumer selects a suit, dress, sweater, or other material, his hands play an important role in the selection. He touches the fabric, rubs it, and perhaps grips it in his hand.

The feel of the fabric makes an impression, either favorable or unfavorable, that helps the consumer make a decision. Hand is the term used in the textile industry to describe the feel of fabric and many terms are used to define hand. Among the most common are soft, crisp, firm, hard, harsh, boardy, dead, lively, wiry, cold, warm, and dry.

The part the hand plays in consumer buying is about the same today as it was many years ago, but in manufacturing there have been some recent changes. Scientific and technological knowledge has provided fabric makers with the capacity to give fabrics the feel that consumers want.

A method to determine more precisely what consumers want in their wool textiles is also being developed by ARS scientists. The approach of the scientists is to—

(1) Regard finished fabric as a communication channel containing information from the manufacturer and the human hand as a receptor that can pick up the information. Sensory centers are present in the hand that are sensitive to roughness, stiffness, heat, cold, and other qualities. These sensory centers are considered to react in on and off fashion to plus and minus (or favorable and unfavorable) stimuli in the fabric.

(2) Apply ideas from modern concepts of information theory, decision theory, and computer analysis to convert information picked up by the hand to mathematical measurements of a fabric's acceptance by consumers for a specific use.

(3) Report the research findings to fabric manufacturers so they can make changes as needed to create the fabric hand consumers like best.

The researchers have derived a mathematical formula in which the fabric hand is expressed as four basic elements of texture. These four elements were arrived at by means of factor analysis techniques. They are roughness, stiffness, compactness, and thermal character.

The terms used to describe the four fabric elements are in plus and minus

371X222–56
With the use of an ionostat, a scientist tests the improvement of soil resistance of wool treated in a corona reactor. Corona treatment also improves resistance to shrinking.

pairs. They are roughness-smoothness, stiffness-flexibility, heaviness-lightness, and coldness-warmth. Panelists rate these terms on a plus and minus scale. Levels on the rating scale range from plus three, extremely acceptable, to minus three, extremely unacceptable.

After panelists have rated the fabrics, the ratings are adjusted to express the human judgment of fabric hand for a specific use. This information is then processed by computer.

Sometimes, fabrics that are processed may acquire characteristics that are not pleasing. When this happens, manufacturers need to change these characteristics to better meet the desires of consumers. ARS scientists are helping to make this possible.

MORE SERVICEABLE LEATHER

LEATHER is a very unusual material. Strong and supple, soft and warm, it makes comfortable, healthful footwear and soft, rich-looking garments. Leather accessories, luggage, and sporting goods are durable and attractive consumer items.

Today's leather is far superior to that worn by the settlers traveling to California 130 years ago. In fact, it is much improved over the leather of 10 to 15 years ago.

Many of the improvements in leather were made possible through the research efforts of chemists and other scientists of the Agricultural Research Service. To meet the changing demands of the consumer, further improvement is needed if leather is to successfully compete with the cheaper, synthetic, leather-like products now on the market.

WASHABLE LEATHER

Leather is hard to beat for some wearing apparel. However, it has its limitations, and keeping the garments looking new is one of the problems. Leather tanned by conventional methods, for example, needs a special cleaning process not offered by every cleaner.

To combat this problem, ARS chemists developed a new tanning process that greatly improves the serviceability of leather. The process uses glutaraldehyde, a petrochemical related to formaldehyde, as the tanning agent. The glutaraldehyde may be used by itself or in combination with either chrome or vegetable tanning agents. It is most often used to retan leather tanned with the other agents.

Glutaraldehyde makes the leather easier to lubricate, color, and finish. Fine leather coats and other garments that are

soft and pliable are being made from glutaraldehyde-tanned leather.

Moreover, the garments are washable and highly resistant to perspiration, acids, and alkalis. This makes them more serviceable and easier to keep clean. It also reduces the cost of their upkeep. The washing does not noticeably affect their softness or beauty.

Chrome-tanned golf gloves, retanned with glutaraldehyde, were test worn for 8 months by 22 active golfers. The gloves wore well and withstood repeated washings (five to eight times) in warm water and soap or detergent without shrinking. A little manipulation after they dried restored most of their original softness. Between washings, the gloves dried without stiffening or cracking no matter how wet they became with perspiration. All the golfers favored the gloves over others they had worn previously.

Glutaraldehyde-tanned leather is also being used for work gloves and other kinds of gloves where resistance to perspiration and launderability are important requirements. U.S. Air Force fliers' gloves are made from the leather because it meets Quartermaster requirements for washability and perspiration resistance.

The leather's high resistance to perspiration, acids, and alkalis makes it particularly suitable for footwear. Workshoes made from the leather are comfortable and durable. They give long service in dairy barns, papermills, cement plants, and other places where perspiration and alkaline agents rapidly deteriorate leather tanned by conventional methods. Many tanners are now using glutaraldehyde in tanning the upper leather for dress shoes.

The success with leather led the scientists to try tanning shearlings with glutaraldehyde. The results were equally good.

BN–37387

Leather tanned by an ARS-developed process, in which glutaraldehyde is used as the tanning agent, makes soft, pliable garments that can be easily washed and drycleaned.

BN-38913
Shearling bedpads, tanned with glutaraldehyde, can withstand repeated washings and sanitizing. The more resilient wool helps to prevent or heal bedsores.

Shearlings are sheepskins with the wool trimmed but not removed. They have long been used as bedpads to help prevent or heal the painful bedsores frequently developed by bedridden patients. However, shearling bedpads tanned conventionally cannot withstand frequent washing and sanitizing; they shrink and harden after five or six launderings.

Shearling bedpads tanned with glutaraldehyde, however, can be laundered and disinfected repeatedly. The leather stays pliable and the wool remains resilient after many washings. During a 3-year test in eight hospitals, a nursing home, and an outpatient clinic, glutaraldehyde-tanned shearling bedpads, retanned with chrome, remained serviceable for 28 months through 54 launderings.

The new bedpads are also easier on the patient. His skin is kept dry by the absorption and removal of perspiration. The more resilient wool helps distribute his weight more evenly, minimizes skin abrasions, allows air to circulate around the body, and provides coolness in the summer and warmth in the winter. All this helps to prevent or to heal bedsores. In the hospital-nursing home-clinic test, both patients and staff members highly praised the bedpads.

Shearling paint rollers, once widely used, are making a comeback in paint stores. When water-based paints hit the market, the shearling rollers gave way to synthetic substitutes which were more resistant to the chemicals in the latex paints. Now, the new glutaraldehyde-tanned shearling rollers resist attack by such chemicals and give water-based paints a better finish.

Shearling ski and after-ski fashions have long been popular because of their warmth. The newer glutaraldehyde-tanned ski jackets and boots are even

more popular because the leather dries out soft and flexible after repeated alternate wetting and drying.

After many washings, the wool facing on shearlings forms dry, tight clumps. ARS scientists found that these undesirable effects may be prevented by adding a fatty, surface-active agent to the final rinse water as a softening agent. This compound is much more effective than the cationic softening agents that housewives buy at the food market or other stores for use on fabrics. Moreover, it is virtually nontoxic, nonirritating, and nonsensitizing.

The scientists also found that the use of the compound as a lubricant in leather keeps the material softer and more flexible after drycleaning. Normally, much of the lubricant is removed by the drycleaning solvent and re-oiling is necessary.

WATERPROOF LEATHER

One reason that leather makes good footwear is that it absorbs the perspiration released by the foot. This keeps the foot relatively dry and comfortable.

This water-absorptive characteristic of leather is also one of its weaknesses. Because it will absorb water, leather will not keep the foot dry in rain or snow unless made waterproof. Leather footwear should be water absorptive on the inside and water resistant on the outside.

Processes have been developed for making leather water repellent, but the most effective treatments are relatively expensive because of the heavy application of repellent required.

ARS scientists developed a process which significantly reduces the amount of repellent needed to make leather resist water satisfactorily. The process involves the use of alkenyl succinic acid (ASA) as a lubricant in the leather.

When ASA is added as a lubricant, only half the usual amount of repellent is required to make chrome-tanned leather satisfactorily water resistant. The leather can be made even more water

0970 B852–4
Glutaraldehyde-tanned shearling jackets and footwear are attractive and serviceable.

ST–1381–2
Leather can be made water repellent more cheaply through an ARS-developed process. .

repellent by retanning it with glutaraldehyde.

This more economical process for making leather water repellent helps make it more competitive with the leather-like products on the market.

MORE ATTRACTIVE LEATHER

Consumers may soon be buying the new washable and drycleanable leather products in red, blue, orange, and other appealing colors.

Truly colorfast dyes are required to manufacture products in different colors. The dyes must be resistant to soapy water and drycleaning solvents.

ARS chemists are experimenting with a series of reactive dyes from which fast colors were obtained for textiles, particularly cotton. One type—the dichloro derivatives of cyanuric chloride—show promise for leather. These are marketed under the trade name of "Procion M."

Satisfactory results were obtained with the Procion M dyes in test washings and drycleanings of both chrome-tanned leather and chrome-glutaraldehyde tanned leather. The dyes remain fast because they become a part of the molecular structure of the leather.

LEATHER RESEARCH

ARS scientists are studying genetic and nutritional effects on hide structure, with emphasis on the defect known as vertical fiber defect. This defect causes the leather to crack during manufacturing. Losses to the industry amount to $5 to $10 million annually.

The scientists are also working on one of today's most critical problems—pollution. They are seeking ways to control the waste that results from the processing and tanning of hides. One way would be to eliminate or reduce the soluble- and insoluble-solids content of tannery effluent.

Consumers can continue to look for improvements in leather—even today's fine material can be made more serviceable and more attractive. Many of the improvements will come through ARS research.

NEW PRODUCTS AND PROCESSES FOR INDUSTRY

THE outstanding growth of American industry since World War II has been accompanied by numerous agricultural research achievements in the development of new and better products and processes for industry.

As an example, ARS now has under study a construction technique called surface bonding of concrete blocks, which eliminates the use of mortar joints in building with these blocks.

Other developments for industry, which ultimately will affect you as a consumer, include:

A method of using linseed oil on concrete to reduce deterioration and the spalling effect of de-icing salts.

New and improved industrial products from corn.

New insect-resistant food packaging to reduce the damage and contamination of food by insects and to decrease the need for pesticides.

A new machine for grading, brushing, and sizing apples without bruising.

A system that automatically removes silage, grain, and concentrates from storage, blends them into a balanced ration, and delivers the ration to livestock feed bunks.

A computerized system to speed up supermarket checkouts promises greater efficiency and economy for both consumers and the food trade industry.

With these and numerous other new developments, agricultural research is pointing the way to improving the quality of living by creating new products for consumers.

Let's take a look at some examples.

WALLS WITHOUT MORTAR JOINTS

A baby stacking blocks in a playpen may be using the same skills later to build himself a house if he follows a new construction technique developed by agricultural engineers.

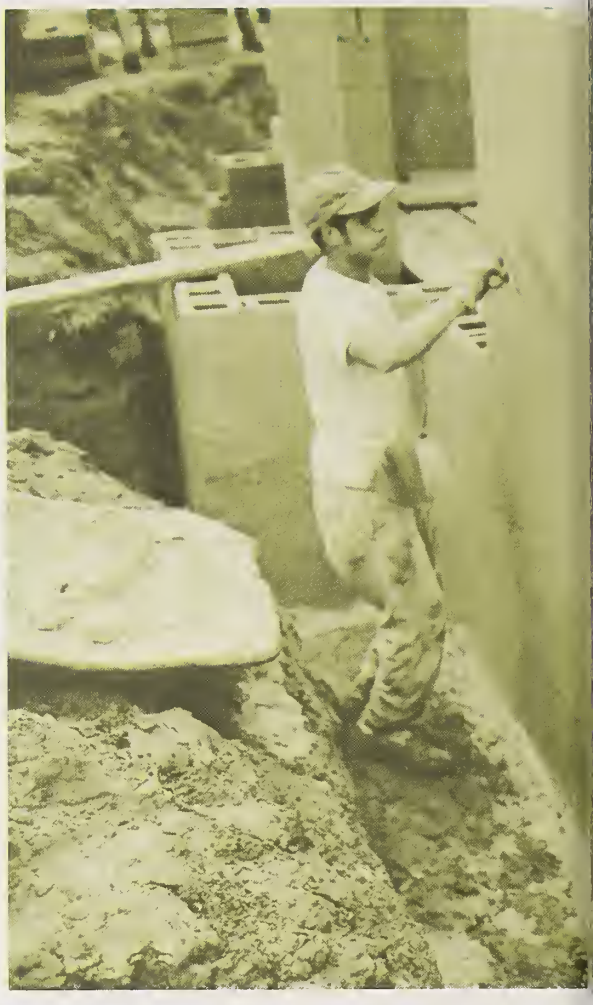
ARS and University of Georgia engineers have developed a method of erecting blocks, which eliminates the need for mortar as the blocks are layed. In the new method, blocks are stacked dry, and the surface bonding mix is later troweled onto both sides of the wall.

Advantages of the new method over the conventional method of laying blocks are that—

- No mortar is needed between the blocks.
- Less skilled labor is needed.
- Walls are two or more times stronger than those with conventionally mortared joints even though thin (1/16-inch or less) coats of the bonding are applied.
- The bonding mixture waterproofs walls in most locations.
- The walls can be colored without painting by adding pigments to the bonding mixture.

The surface-bonding mix consists of a cement grout and the following ingredients:

- Hydrated lime, which makes the mixture more workable and easier to apply.
- Calcium chloride, which reduces the initial setting time of the mixture and makes a harder surface.
- Calcium stearate, which improves the waterproofing quality of the mixture.



- Fiberglass filaments, chopped to ½-inch lengths, which strengthen the mixture.

Even with skilled labor, savings are possible when compared with cost of conventional block laying because of reduced labor needs and lower material cost.

A fringe benefit of the new method is that the coating covers cracks in the blocks. Because some glass fibers are only partially embedded, the wall has a pleasing surface texture.

671 X 783–9 and
671 X782–70
Concrete block walls are stacked dry and then surface bonding mix is applied to them.

The bonding mix can be trowelled on by hand or applied with stucco spraying equipment and then trowelled smooth. Engineers are working on new mechanical equipment to further reduce the time needed to apply the mix.

What are the applications of surface bonding? Besides low-cost housing units, it can be used for farm structures, garden planters, enclosure of carports, and patio walls.

Although the application of surface bonding to the construction industry is receiving increased attention, the potential presently is relatively untapped. Researchers foresee the day when surface bonding will be used to build thousands of new homes.

LINSEED OIL AIDS CONCRETE HIGHWAYS

Each spring the ravages of winter appear on our bridges and highways in the form of concrete spalling. Motorists see this damage as they drive over the Nation's highways and feel it when they hit a bump.

Spalling occurs when water penetrates concrete and alternately freezes and thaws. Salt used to melt a covering of ice or snow accelerates this action. The concrete surface deteriorates and weakens. Damage is the result.

To combat spalling a linseed oil emulsion was designed to cure fresh concrete and to help maintain cured concrete. Concrete curing is designed to limit rate of drying. Slower drying makes stronger concrete. At first the treatment involved applying separate curing and antispalling agents 30 days apart.

Now ARS scientists at Peoria, Ill., have designed a stable linseed oil-water emulsion that permits curing and antispalling treatment in one application. They tested it on sidewalks in Peoria and Washington, D.C., and on bridge patches in Colorado City, Texas.

Sprayed on fresh concrete in any kind of construction from do-it-yourself projects to industrial warehouse or public bridges, the emulsion acts first as a curing agent. The residue remains on the concrete for at least two years and acts as an antispalling agent on roads and bridges. It can be sprayed on older concrete for antispalling protection alone.

Half water, it is inexpensive and less flammable and less polluting than materials that contain flammable solvents.

Oklahoma became the first State to require linseed oil emulsion for curing concrete bridges. Highway engineers find that bridge floors cured with the emulsion crack less than floors cured with materials previously used. They apply a second treatment of linseed antispalling agent after the bridge has been under traffic for two years.

In continuing studies, scientists want to learn how linseed oil protects concrete and to define the degree of protection given by the emulsion and by other vegetable oil products.

CORN DERIVATIVES

Increased use of corn continues to be one of the primary goals of agricultural scientists. Because starch is the major constituent of corn, research has emphasized studies on derivatives and modifications of corn starch and fermentative conversion of corn sugar into new industrial products.

Earlier work on starch xanthates and related products as reinforcing agents in rubber has led to developments of powdered rubbers to which starch has been added. These materials, like powdered plastics, can be molded or extruded without prior high-shear milling to give high-quality finished products.

Industry has tested powdered rubber and estimates that its use would reduce processing costs at least 2½ cents per pound of finished rubber goods. The powdered product eliminates much of the heavy-duty equipment and power needed to incorporate curing and reinforcing agents, fillers, and other additives into slab rubber.

Mechanical rubber goods, footwear, and miscellaneous types of molded rub-

ber articles constitute a 3.4 billion pound-per-year market in the United States.

Xanthan gum, a water-soluble polysaccharide, is an example of a product obtained by the action of microorganisms growing on corn sugar. This product has been widely acclaimed for its unique properties during the 7-year period of its availability as a nonfood thickener. It is used, for example, to control viscosity (thickness) of lubricating fluids in oil-well drilling, where heat and salt are encountered.

As an outgrowth of cooperative research between agricultural and industrial scientists, xanthan gum, manufactured from corn sugar by a USDA process, has received Food and Drug Administration (FDA) approval for use in food.

FDA approval opened the way for its use as a stabilizer, emulsifier, thickener, suspending agent, bodying agent, or foam enhancer in foods. Thus, xanthan gum is a corn starch-derived product now on grocers' shelves in foods like salad dressings and relishes.

Other studies to increase outlets for corn include:

- Developing low-cost foods from new corn varieties having higher nutritional value than ordinary dent corn.
- Developing more acceptable, varied, and nutritious foods from dent corn.
- Developing methods of detecting potential mold toxins or microorganisms in stored grains.
- Developing techniques for the detection of microorganisms or their metabolites.

INSECT-RESISTANT COTTON BAGS

Changes in food preferences, processing, and marketing have forced structural and functional changes in the design of food packages. Consumers can see how the packaging industry has met this challenge, by walking through a modern supermarket and noting the various types, shapes, sizes, colors, and uses of containers displayed.

However, one challenge the packaging industry has not fully met is the production of flexible or semirigid packages that resist insects.

Because insect damage to raw and processed food costs the American consumer millions of dollars annually, intensive research was initiated by ARS at Savannah, Ga. and New Orleans, La., to develop a practical insect-resistant textile bag.

There are more than 50 common species of stored-product insects, one or more of which can infest practically every plant and animal product used by man. Many of these insects feed on dry cereal products such as flour and cornmeal.

Scientists began their studies with tape-over-stitch cotton bags treated with a repellant. Heat-sealed tape was applied over the open-mouth stitched closures of the bags. Further studies also explored combinations of cotton and paper piles for bags. Finally the bags were included in a large scale overseas shipping test. The results—

- Bags constructed with an outer insect-resistant treated (IRT) cotton ply (loosely tacked to a waxed, crepe paper liner) protected dry cereal products from insect infestation during the overseas shipping period. These bags be-

TOM–I&G–0–23

A market quality researcher classifies green tomatoes into maturity-date categories.

came infested, however, during the following 6-month storage period.

- Bags constructed with an outer ply of IRT kraft paper tightly laminated to cotton fabric—and with a waxed, crepe paper liner—provided protection from infestation during shipping and during the 6-month storage period.

FOOD PROTECTORS

Will automation replace the thumb—that device well known to grocery store managers and used by shoppers to feel plums, peaches, and tomatoes?

Agricultural researchers have developed a new instrument that uses sound waves to sort fresh fruits and vegetables for ripeness and internal defects.

By passing sound waves through a fruit or vegetable, scientists can determine its softness or firmness by comparing its natural frequency to the standard for the type.

Eventually, the researchers believe, these instruments will tell producers when to harvest their crops for the best quality, and tell packers when to take produce out of storage and put it on the market for peak flavor.

Another promising technique using light transmitted through fruit is being tested. This will enable growers to sort blueberries according to ripeness.

In other research to protect food quality—

- A machine was developed for grading, brushing, and sizing apples without bruising them.
- A package—a molded pulp tray—was developed for protecting apples from bruising. These trays have deep pockets that protect the apples better than the commonly used shallow cup tray.

TOM-I&G-0-32

With current warehouse storage procedures, tomatoes ripen unevenly.

- A storage system with a controlled atmosphere was developed to maintain quality of fruits.
- A railcar specially designed for hauling fresh food products in bulk promises to save industry millions of dollars annually. It could become a major link in the chain of mechanized systems for moving commodities from farm to market.

Investigators are also looking for better ways of transporting food to the consumer. A prototype van container—a trailer "reefer" without wheels—was developed. The van container—a light, compact unit—can be transported by railroad flatcar, ship, or airplane. It makes possible simultaneous shipping of several kinds of food having different refrigeration requirements.

Marketing researchers are working closely with industry to improve the overall quality of agricultural products. We can expect them to be better tomorrow.

TOM–I&G–0–34

Tomatoes sorted by a multiple wavelength difference meter can be sent from warehouse to retailer with a predetermined maturity date, eliminating spoilage.

Better products will be produced and prepared for market; automated instruments will measure and control the quality; and better storage, transportation, and packaging will protect products from the farm to the consumer.

HARVESTING MACHINES

A mechanical harvester for red tart cherries may mean as much to 20th-century cherry growers as the gin and reaper did to 19th-century cotton and grain farmers.

It may even have saved cherry pie, one of America's most popular deserts, from becoming a rare treat.

Picking cherries by hand is hard, slow work. The harvest season is short—a

mere 3 weeks—and workers are often scarce. Relief is now in sight.

Agricultural engineers and horticulturists developed equipment and methods that—

- Reduced the number of hand pickers.
- Lowered picking costs.
- Helped maintain on-the-tree fruit quality.

Various types of shaking and collecting equipment were tried during 3 seasons. Studies showed that mechanization saves time, money, and labor.

A tractor-mounted, hydraulically activated shaker (it has a boom with a claw at the end) removed 95 percent of the cherries from trees. The cherries left on the trees were undersized and lacked color and maturity.

Several types of lightweight rectangular or semicircular folding canvas units were designed to catch the cherries. Various combinations of catching and conveying equipment were developed.

In other ARS research on gathering fruits—

- A harvester has been designed for apples destined for processing; it can also work for peaches, pears, and plums. The efficiency of workers is increased 10-fold over conventional hand harvesting.
- A machine has been designed to harvest tomatoes—vines and all. It harvests tomatoes developed to withstand rough machine handling.
- An aid is available for harvesting fruit and pruning fruit trees. The worker rides in a basket that moves up and down and in and out. He uses foot pedals to control the movement of the vehicle around the tree, and thus has both hands free for working.

Growers have accepted the fact that mechanization is necessary and that eventually it will replace most handpicking operations.

AUTOMATED FEEDING

Farmstead mechanization has increased dramatically in recent years. Demand for industrial processing equipment is increasing as farms automate more and more of their operations to improve efficiency and offset rising labor costs.

Automated systems for mixing and distributing livestock rations can reduce the man-hours for feeding cattle by 75 to 80 percent. These systems are now commercially available and economically possible.

A new method that shows promise in research studies at Urbana, Ill., conveys feed pneumatically under medium pressure.

The overall system first moves various ingredients from storage; meters, blends, and grinds them; and then pneumatically conveys the mixed ground feed to one of four feed bunks. Feed flow is 1,200 pounds per hour through a 1-inch pipe.

This system includes safety features to prevent delivery of an improperly mixed ration. If a particular piece of equipment fails to do its job, automatic shut-off occurs and a warning circuit is energized.

Getting feed into an automated pipeline feeding system has been made easier by a new auger-type feed injector.

The device has two primary advantages; it costs considerably less than rotary-valve injectors, now used on most commercial pipeline systems, and it never needs adjusting.

Adjustments are not necessary on the

auger-type injector because its operation does not depend on closely fitting airtight parts. Feed moving through the injector creates its own airtight seal.

The auger injector promises wide adaptation in industry, particularly for flour, pulverized coal, cement, and other free-flowing materials.

M&M-RETAIL-6-37A
An electronic scanner is used at a checkout counter to read coded labels on grocery items.

M&M-RETAIL-6-13

The cashier touches the scanner to the code label on each item of a grocery order. The scanner reads the code and sends the information to the computer, which identifies the product and its current price.

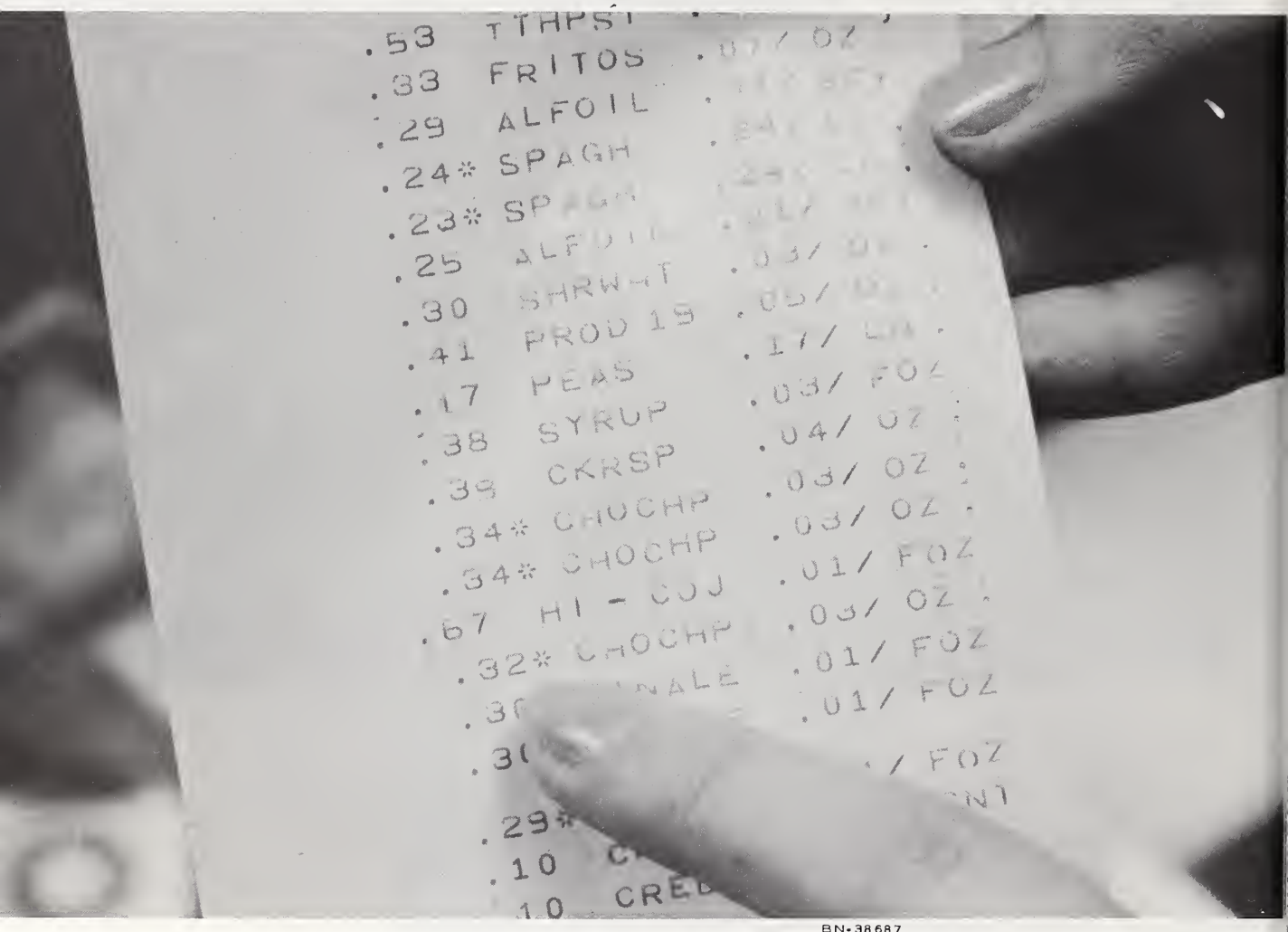
Pneumatic systems are popular in industry because of ease of installation, automatic controls, and the limited amount of dust that is generated at discharge points.

AUTOMATIC CHECKOUT

A computerized system to speed up supermarket checkouts promises greater efficiency and economy for both consumers and the food distribution industry.

The improved checkout system will—

- Eliminate ring-up error and insure accurate pricing.
- Provide customers with itemized and detailed records of purchasing.
- Cut labor and management costs



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The name of the grocery item together with its total price and unit price is printed on a receipt tape for the customer.

by eliminating individual marking and changing of prices.

- Automate the ordering of shelf replacements, and provide a continuous inventory.
- Save shoppers time through more rapid checkout at the store.

Four pieces of equipment are linked to form the computerized checkout system—a tabulator, a teletype, a computer, and the key component—an electronic scanner that "reads" coded labels on the grocery items.

The code label, a small round disk affixed by the food manufacturers, can record 100 million characters to identify the specific size, brand, and weight of grocery products.

At the checkout counter, the cashier touches the scanner to the code label on each item of a grocery order. The scanner reads the code and sends the information to the computer, which identifies the product and its current price. Then the name of the product together with its total price and unit price is relayed to the tabulator, and the information is printed on the receipt tape.

When the entire order has been checked out, the customer receives a tape itemizing each purchase by name along with package price and unit price. The total cost of the order is shown at the bottom of the tape together with any tax, number of stamps due if they're used, and credits for "cents off" coupons, and the adjusted total.

The computerized system, while benefiting the consumer, holds even greater potential for the food industry by providing a broad spectrum of management information and service.

As groceries are checked out, the computer, which can service as many as 60 checkout counters simultaneously, maintains a continuous stock inventory.

At any given moment—but usually at the close of the business day—the teletype can be activated to retrieve inventory data from the computer and print it out on a sheet. The sheet contains the name and code number of each product, the quantity on hand at the beginning of the day, the quantity sold, and the remaining stock balance.

In case of price changes, the computer is reprogrammed to match a particular product with its new price, thus eliminating marking out of one price on a product and adding a new one. Similar efficiencies will be available at the warehouse.

Further, regional and national offices will be better able to monitor and predict merchandising trends.

Although automatic checkout is in its infancy, it has excellent potential and is destined to play a growing role in all aspects of daily life.

NEW INDUSTRIAL CROPS

Two promising new plants—crambe and kenaf—have been found in a broad research effort to develop new crops for industrial markets.

These crops are expected to provide farmers with additional sources of income without competing for industrial markets now supplied by domestic crops. They may give rise to new industries, important in rural development.

In addition to examining the new crops for promising new products for pulp fibers and oils, researchers are evaluating kenaf tops for feed and crambe seed meal for feed.

Here are some of the highlights of their findings:

CRAMBE—This species is the first new industrial oilseed to be grown commercially. Crambe has been widely tested for adaptability and yield. Commercial acreage has fluctuated rather widely over a several-year period.

Crambe seed is high in oil that contains about 60 percent of erucic acid. The oil has superior properties in special lubricants including those for molds in continuous casting of steel. The oil may also be converted to a variety of promising products such as plastic additives and a new industrial nylon with excellent properties for the manufacture of films, adhesives, gears and bushings, and molded mechanical parts.

KENAF—This relatively minor fibre crop, is creating interest in some parts of the world as a possible source of pulp in paper-making.

If it makes the grade, kenaf could become a major crop in countries that are short of wood and other sources of pulp for paper-making. Presently, kenaf is grown for its outer bark which is used for the manufacture of twine, rope, and other cordage.

Kenaf pulping does not present any unusual problem. A commercial-type bond paper can be obtained from it. In addition to its good pulping characteristics, kenaf is an easy crop to grow and is adaptable to mechanized farming.

Kenaf appears best adapted to the southeastern United States which is characterized by warm temperatures and abundant moisture. In this area, the crop yields as much as 10 tons per acre.

Those working with the new crop see it as another source of pulp for the expanding pulp and paper industry. It would also contribute to the rural economy by providing a new cash crop for farmers.

ARS scientists find kenaf papers have strength characteristics equal to those of softwood pulp papers and superior to many made from hardwood pulps. Kenaf may also be used as a blending agent to improve pulp quality.

Coupled with increased demand for pulpwood, especially hardwood, and the increasing costs of timber harvesting and pulping, kenaf seems to have an excellent chance for commercialization within the next few years.

TAILORMADE BEES DO HONEY OF A JOB

Instead of dividing their attention among a variety of flowering plants, honey bees bred for crop preference may head straight for blossoming alfalfa —or other "target species."

In the past, controlled breeding of the honey bee has been concentrated on improving honey-producing capabilities. In recent years, beekeeping has moved rapidly toward an industry that provides pollination services.

About 90 crops grown in the United States are dependent on bees for pollination. To develop special pollinating strains for each of these is not practical. Crops that require bee pollination—hybrid cotton and red clover, for example —might profit from bees bred to prefer their blossoms over other flowering crops.

Scientists investigated the pollen collecting activities of large numbers of colonies located in alfalfa seed production areas of Utah. Having found differences in the tendencies of colonies to collect alfalfa pollen, scientists started a breeding program designed to determine if these characteristics were inheritable.

In bee breeding experiments in Baton Rouge, La., an entomologist discovered

that honey bee preference for alfalfa pollen is an inherited trait. He then bred bees for this trait. Increased alfalfa crop preference of bred bees was later confirmed in experiments conducted in Utah. In the process of collecting alfalfa pollen, the bee performs the cross-pollination required by alfalfa for seed production.

The present method of instrumental insemination (hand mating) was developed by ARS scientists. It made possible the controlled mating of queen and drone bees which normally takes place in the air. Instrumental mating is also making possible the increased knowledge of bee genetics required for intelligent bee breeding.

To develop a commercially acceptable line of bees, breeding for crop preference must also include such desirable factors as good bee temperament, vigor, disease resistance, and high brood and honey production capabilities.

Genetic studies will also be expanded. Tests so far indicate that the trait for crop preference is a result of factors carried on a number of genes, and further work is needed to improve our understanding of the genetic mechanics involved.

INDUSTRIAL PRODUCTS FOR TOMORROW

Over the years, agricultural scientists have replaced existing products with new and better ones. Newer products to aid industry are expected to come from continued research.

What about the future?

A great opportunity lies ahead in wider industrial use for cereal grains, for example. Research scientists see possibilities of diverting millions of bushels of cereal grain from feed and food to new industrial uses.

Researchers have also developed:

- Adhesives from starch which have better water resistance, greater holding power, and other desirable properties.
- Instruments to provide information on the quality of cotton so that producers and purchasers will be able to determine the market value of cotton with specific fiber properties.
- Detergents made from animal fats that are readily broken down by microorganisms in streams, soil, and sewage-treatment systems.
- Machines to cut up chickens and help broiler processors who are beset by rising labor costs.
- Honeycombs made from plastic that increase honey production and are heat resistant.

Agricultural research, used in man's service, can help us improve our national economy, provide industry and consumers with new products, and help others in the world community to help themselves.

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